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INDEX TO NAMES.

INDEX TO SUBJECTS.

(vi)

JOURNAL

OF THE

Boston Society of Medical Sciences

EDITED BY

HAROLD C. ERNST, A.M., M.D.

For the Society

BOSTON
MASSACHUSETTS
U. S. A.

SPECIAL NOTICE.

The Journal will be published *immediately* after the meetings of the Society, and will contain authors' abstracts of the papers presented, when these papers are not given in full.

By general consent of the Heads of Departments it will contain full abstracts of experimental work carried on in the following institutions: the Medical School of Harvard University, the Experiment Laboratories of the Massachusetts General and the Boston City Hospitals, the Physiological and Biological Departments of the Massachusetts Institute of Technology, Clark University, and the Anatomical Laboratory of Brown University.

Papers and abstracts of papers upon subjects connected with the Medical Sciences will be welcomed from persons not members of the Society, and if approved by the Council will be presented at the meetings, and will be given a place in the Journal.

When desired, the insertion of papers, if in abstract, will be accompanied by a note indicating the place where they may be found in full. Fifty reprints will be furnished free to authors if the desire for them be expressed on the manuscript.

Subscribers to the Journal are invited to attend the meetings of the Society; the next will occur January 18, at the Harvard Medical School, at 8 P.M.

All communications should be addressed to the Editor,

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Boston Society of Medical Sciences.

VOLUME II. No. 4.

DECEMBER 21, 1897.

At the meeting held Dec. 21, 1897,

Dr. H. C. BUMPUS (of Brown University) presented a paper on

"A POSSIBLE CASE OF MUTATION,"

illustrated by specimens of the Winter Flatfish (*Pleuronectes Americanus*).

It was shown that within recent years many specimens of the common flatfish have tended to vary in a definite direction. The lower (left) surface of the body is frequently pigmented over a more or less definite tract, which resembles, even in minute details, the coloring of the upper side. It was argued that the coloration could not have been the result of the direct action of light, because the lower surface of the head was as colorless as in normal fish, and the colored area often began at a definite line immediately back of the gill-opening.

The scales of the lower side of these variable fish resembled not only in color, but also in structure, the scales of the upper, exposed side.

The sudden appearance of numerous examples of this variety would indicate that the variation is due to some changed environmental condition without or within the fish, for it is improbable that a large number of individuals would fortui-

tously vary in a definite direction at a definite time. Since the causes which have produced the coloration of the lower side have evidently acted with considerable uniformity and upon a large number of individuals, the change that has been wrought is of the nature of a *mutation*, though it is not likely that the process of natural selection has, at least as yet, exercised any controlling action.

Dr. CHARLES HARRINGTON gave an account of some experiments conducted by him in an investigation of

"FORMALDEHYDE AS A PRACTICAL DISINFECTANT."

The agent was used in two forms, the ordinary 40 per cent. solution ("Formalin") and the pastilles of polymerized formaldehyde ("Paraform"). The former was used both in an autoclave and in an open cylinder heated over a gas-stove. The latter were volatilized in a Schering lamp.

The organisms regularly used were staphylococcus aureus, typhoid, anthrax spores, and a highly resistant non-pathogenic spore-bearing bacillus; other forms were used occasionally. The cultures other than those of the spore-bearers were always from 24 to 48 hours old; those of the spore-bearers were from 4 to 10 days old.

The first experiment was conducted in a room of 7660 cubic feet capacity. The test objects were "smears" of the above-mentioned organisms and diphtheria, exposed open, and also placed between the leaves of closed thin blank-books, dishes of infected water and milk, wet surgical dressings, infected bedclothes, typhoid stools, and various other articles. Some were protected by wrappers of paper or cotton, some were loosely covered with glass dishes; some were exposed open on desks and shelves, others placed in cupboards and closed drawers, in a covered barrel, in a thermostat, and in a hood. Flasks of decolorized fuchsin solution, stoppered with cotton, were well distributed at different heights throughout the room, as chemical tests of the presence of the gas and of its ability to penetrate dry porous materials.

The introduction of 650 c.c. of formalin through the key-hole by means of an autoclave proved to be quite insufficient to kill all exposed organisms after fifteen hours' interval. As soon as the cultures were taken the experiment was resumed, and after 2150 c.c. additional had been intro-duced the room was left undisturbed over night. Cultures taken on the following morning showed negative results in every case where the test objects were exposed dry or nearly so, and in a fair proportion of those in which they were loosely covered or shut up in drawers, cupboards, and simi-lar places. The "smears" in the blank-books, the uncov-ered dishes of water and milk, and dust from the cracks of the floor and from shelves were sterile. The objects which escaped action were mainly wet, or decidedly moist, and were both exposed and protected. They included the surgical dressings, infected bedclothes, covered dishes of water, and pitchers of infected milk. Of the 33 flasks of decolorized fuchsin, all but one showed decided restoration of color.

The experiment was repeated in a larger room of 10766 cubic feet capacity. In this case, 4250 c.c. of formalin mixed with 3000 c.c. of water was evaporated from an open vessel until but 1200 c.c. of the mixture remained. The test objects were practically the same as before, and the results were also in substantial agreement.

A third experiment made in a small room of 1500 cubic feet capacity demonstrated that 20 pastilles of paraform were quite inadequate for the sterilization of exposed "smears" of the cultures regularly employed, but sufficient for diplococcus intracellularis meningitidis.

A fourth experiment with 130 pastilles in a room of 4560 cubic feet capacity was completely successful against exposed "smears," but not so as to dust from several points in the flooring and elsewhere. It was repeated with double the number of pastilles and a large number of "smears" on paper, some of which were enclosed in bags of heavily sized cotton distributed throughout the room. Two were enclosed in open Erlenmeyer flasks and introduced well into the interior of a hair mattress. Several wet dressings were also intro-

duced.   Practically everything was sterilized excepting the dressings.   Again it was repeated, using the same amount of paraform, and again was the same result.   A series of similar experiments in small spaces gave results which were in agreement with those already found, both as to the germicidal and penetrating power.

The conclusions derived from all the experiments were that:

1.   Formaldehyde has extraordinary power as a surface disinfectant.

2.   That its penetrating power is slight.

3.   That it cannot be depended upon in the presence of abundant moisture.

4.   And that for all practical purposes it must be regarded as a surface disinfectant only.

(Details of these experiments may be found in the "American Journal Medical Sciences," January, 1898.)

In the Discussion,

Dr. J. H. McCOLLOM said:

I have made a few limited experiments with formaldehyde, but the method adopted was a little different from that used by Dr. Harrington.   In the first series of experiments I used an autoclave.   A small room with a capacity of 2000 cubic feet was taken.   The window and registers were tightly closed by pasting paper over them.   In these experiments cultures in bouillon of diphtheria bacilli, of typhoid bacilli, and of the pus cocci were used.   These cultures were smeared upon pieces of cloth and suspended in different parts of the room. Cultures of various organisms on blood serum in plugged tubes were also used.   Pieces of cloth smeared with the discharge from the nose of a patient with nasal diphtheria, pieces of diphtheritic membrane on tongue depressors, were also exposed to the gas.   Two rabbits were placed in the room. The amount of formalin and calcium chloride used was rather more than is generally considered sufficient.   The gas was introduced into the room through the keyhole, the door having been tightly sealed by pasting paper over the cracks. Gas was passed into the room for about one hour and a

half, and the room was closed for eighteen hours. At the end of this time the pieces of cloth that had been smeared with the cultures and with the nasal discharge were placed in bouillon and put into the incubator. The pieces of diph‑ theritic membrane on the tongue depressor were also put in bouillon and placed in the incubator. The rabbits died, one in about half an hour, the other in about three-quarters of an hour, after the introduction of the gas. At the end of four days there was no growth in the bouillon which con‑ tained the smears and the diphtheritic membrane. The plugged tubes did not seem to be affected by the gas, as luxuriant growths were obtained from them. In every in‑ stance control cultures made from the smears just before they were exposed to the action of the gas gave positive evidence of the vitality of the organisms. A large number of pieces of cloth of bright colors were exposed at the same time, but without any effect on these colors.

(NOTE. — The non-change of color was explained by Dr. Harrington as being due to the fact that formaldehyde, being an oxidizing agent, would not probably remove the brilliancy of the aniline dyes, to which the colors spoken of by Dr. McCollom were due.)

In the second series the formaldehyde was obtained by volatilizing pastilles of formalin in a specially constructed lamp. The experiments were made in the same manner as in the first series, with a like result; no growths were obtained from the cloth exposed directly to the gas.

In a third series pieces of cloth were smeared with cultures in bouillon of different organisms, and also from a nasal dis‑ charge loaded with the bacilli of diphtheria. These pieces of cloth were put in the pocket, in the sleeve, under the lining of a coat, and the coat was loosely folded and placed on the back of a chair. The same number of pastilles were used as in the previous experiments and the time of exposure was the same. At the end of eighteen hours these smears were put in bouillon and placed in the incubator. In from sixteen to eighteen hours the bouillon became cloudy, showing an abundant growth. Cover glasses made from the bouillon revealed the presence of all the organisms on the smears.

Cultures from the bouillon developed abundant growths of these organisms, proving that their vitality had not been impaired in the least.

It therefore seems evident, as Dr. Harrington has said, that formaldehyde, although an exceedingly good surface disinfectant, has very little penetrating power.

The statement that is made in the literature of the subject, that this gas, although destructive to bacteria, does not injuriously affect animal life, must be considered incorrect.

The statement also made, that it is possible to disinfect a room with a patient in it, must be considered to be without foundation.

Dr. E. W. TAYLOR reported

"A CASE OF HYDROCEPHALUS DUE TO MECHANICAL OBSTRUCTION IN THE FOURTH VENTRICLE."

The specimens are from a child of approximately four months, who died November 17, 1895, at the Infants' Hospital.

Spina bifida had been observed since birth; hydrocephalus began to show itself toward the end of the second month. When admitted to the hospital, eleven days before death, the cranium was typical of an extreme hydrocephalus, the spina bifida of the lumbar region was soft and flaccid in comparison.

Autopsy showed enormously dilated ventricles, including the fourth ventricle. (Specimen shown.) At the lower portion of the medulla oblongata, a tumor-like mass, closely associated with the cerebellum, had taken the place of the ordinary thin epithelial covering of the ventricle at that point, occluding the area (Foramen of Majendie), by means of which an interchange of fluid between the brain cavities and the sub-dural space of the cord is possible.

The spina bifida was of the type of a meningomyelocele. (Specimen shown.)

Microscopic examination of the mass occluding the ventricle and the neighboring tissues showed an extreme

distortion of the normal anatomical arrangement as regards cerebellum and medulla. The space normally existing between these structures was occupied by a tissue infiltrated with cells of various characters, some of them evidently epithelioid and others of the type seen in inflammatory processes. The exact nature of the process remains as yet undetermined. Several possibilities suggest themselves:

1. The results of congenital syphilis.

2. Proliferation of ependyma (not sufficient to explain the whole process).

3. An inflammatory affection which has become chronic.

4. A new growth, sarcomatous in type.

5. A congenital malformation; an idea which the coincident spina bifida would strengthen.

A combination of two or several of these processes should be considered. Of interest, apart from histological details, are the facts that the hydrocephalus was apparently acquired, and that it was due to an unusual cause in an unusual position.

Dr. TAYLOR also demonstrated:

"THE SPINAL CORD IN A CASE OF ANENCEPHALUS."

This case occurred in the practice of Dr. E. L. Twombly, and has been reported by him. Autopsy by Dr. A. H. Wentworth; microscopic examination by writer.

Of interest in the clinical history is the fact that the infant lived sixteen hours, in spite of its cerebral defect. Autopsy showed a perfectly well-formed child, normal except for the central nervous system. The cranial vault was not closed in (specimen shown), and no differentiated brain tissue could be made out. No spina bifida. Medulla and spinal cord removed with probably some injury to the upper portion of the medulla. Cord extremely small, approximately one-half the diameter of the cord of a normal infant at birth.

Microscopic examination showed deficiency of corticospinal motor tracts (pyramidal tracts, neuron of 2d order) as shown by lack of the space in the postero-lateral portions of the cord, which these fibres normally occupy. Since

these fibres are at birth non-medullated the deficiency is not so apparent as would otherwise be the case. Many fibres which stain well with Weigert's hematoxylin are apparent in that region of the cord normally occupied by the pyramidal tracts, which would tend to show that the pyramidal tract is not made up of unmixed motor fibres. Of greater interest is a group of decussating fibres in the lower medulla, with sharply stained myelin, occupying the space anterior to the central canal in the position of motor fibres, which they cannot be; first, because of their medullization, and secondly, because of the absence of cerebral cortex. They are probably not a part of the sensory decussation; their origin remains, as yet, undetermined.

Sensory portions of the cord are well developed, likewise the anterior horns, and contained cells with their neuraxon processes. Worthy of mention is the fact that the development of the neuron of 1st order (spinal-peripheral) is shown, by this observation, to be in no way dependent upon that of the neuron of the 2d order (cortico-spinal), a further suggestion of the correctness of the now generally accepted theory of nerve anatomy.

Prof. EDW. F. MILLER showed and described

" AN ADJUSTABLE CHAIR"

for schools and offices.

About a year and a half ago a committee consisting of five members, Drs. Bowditch, Wadsworth, Bradford, Hartwell, and myself, was appointed to investigate the subject of adjustable school furniture for school-seating.

As there was nothing in the line of adjustable school furniture either here or abroad that was entirely satisfactory, the committee has constructed one or two experimental chairs with the hope that builders of school furniture may profit by and improve upon the good points of each chair.

It fell to me to carry out mechanically the ideas of the committee, and it is simply to explain the mechanical side of this chair that I am here this evening.

The two styles of adjustable furniture in most common use are the Chandler and Bobrick.

In each of these the heights of both chair and desk can be varied to suit the requirements of the pupil.

The top of the desk is made to slide, thus enabling the pupil to bring the desk nearer to his body when he desires to use the desk for writing or drawing.

FIG. 1.   FIG. 2.
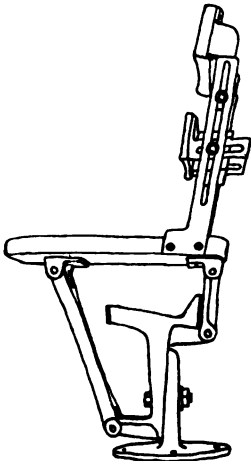
Chair in forward position for   Chair in backward position for
        writing.   reading.

AN ADJUSTABLE CHAIR for schools and offices, described and shown by Prof. E. W. Miller, of the Massachusetts Institute of Technology, before the Boston Society of Medical Sciences, on December 21, 1897.

The chair after being set at the proper distance from the desk and at the right height cannot be moved by the pupil.

The chair which I have here shows the line along which the committee thought improvement could be made.

This is an experimental model built up from an old school-seat; the iron is very much heavier than it need be, and other details can of course be much improved. It will, however, serve to show the principle.

By a method similar to that used by the Chandler or Bobrick Company, the seat can be raised or lowered to suit the height of the pupil.

The seat is carried by two cast-iron links running up from the movable casting which forms the upper part of the pedestal.

The links turn on pins at either end. The link at the front is much longer than the link at the back.

The castings screwed to the chair bottom, and to which the upper ends of the links are attached, are so located that when the pupil is leaning forward (as he would be when about to write) his centre of gravity falls to the front of the supporting pedestal and the links come into the position shown. (Fig. 1.)

As the pupil leans backward his centre of gravity falls back of the supporting pedestal and the links move into this position. (Fig. 2.)

In the first position the back link comes up almost to a vertical line and the chair bottom is level; at the same time the chair seat is carried forward toward the desk about three inches. This obviates the necessity of a sliding top on the desk.

In the second position the front link is almost vertical and the short back link has lowered the back of the seat so that the chair is now tipped backward.

As the links come up toward the vertical they bring up against rubber buffers which prevent noise and shock.

By dropping the back of the seat it is believed that on account of the more comfortable position in which the pupil sits there will be less tendency for him to slide down on the small of his back.

By the use of the long link on the front side and the short link on the back side, the chair may be tipped back while raising the front edge but little, thus avoiding the danger of stopping the circulation of blood in the legs.

A number of experiments were made with chair backs.

The back of this chair has but two horizontal cross-bars, each made adjustable.

The top bar is adjustable in height and the bottom bar is adjustable both vertically and horizontally.

By loosening four screws, two on each side, both supports can be moved and fitted to the back of the pupil.

Probably three sizes of chairs would be needed to cover the grades from the kindergarten through the high schools.

This chair would be more expensive than those now in use, but since the desk would not need to have a sliding top its cost would be cheapened, so that the total cost of both desk and chair would be but little greater than at present.

Dr. C. F. HODGE (of Clark University):

"ACTION OF ALCOHOL ON DOGS AS REGARDS NON–VIABILITY AND MALFORMATION OF THE YOUNG, AND SEVERITY OF ATTACK IN AN EPIDEMIC OF DISTEMPER."

The following observations were made upon the kennel of cocker spaniels kept by myself, for the Committee of Fifty, to study the physiological influence of alcohol upon the vital functions of the animals as a whole. The general setting of the experiments with some of the results obtained up to within a year have been described ("Popular Science Monthly," April, 1897). In view of the importance of developments along the two lines indicated in the title, it has been thought best to make the following brief report:

The main feature in the conduct of the experiment may be re-stated at this point, viz.: that normal dogs, brothers and sisters from the same litters, have been kept to control at every step the findings in the alcoholic animals. And second, the amount of alcohol given, 40 ccm., is not sufficient to pro-duce intoxication, being about 4 ccm. per kilo of body weight. This treatment has continued from May, 1895 (the dogs having been born Feb. 22, 1895), up to the present.

Both pairs have produced three litters of pups up to date, an analysis of which may be seen in the following table:

	Alcoholic pair. (Bum-Tipsy.)		Normal pair. (Nig-Topsy.)	
Number of whelps . . .	(7 – 7 – 6)	20	(5 – 3 – 8)	16
Malformed . . .	(2 – 3 – 3)	8	(1 – 0 – 0)	1
Born dead . . .	(2 – 2 – 2)	6	(0 – 0 – 0)	0
Viable	(4 – 0 – 0)	4 20%	(4 – 3 – 8)	15 94%

(Numbers in parentheses stand for the number of pups in the successive litters.)

The significance of this result is enhanced by comparison with similar findings among human subjects, notably those of Demme, who compared the children in ten families addicted to abuse of alcohol with those in ten temperate families. (R. Demme. Einfluss des Alkohols auf den Organismus des Kindes. Stuttgart, 1891.)

	In ten alcoholic families.		In ten temperate families.
Total number of children .	.	57	61
deformed	.	10	2
idiotic .	.	6	0 (2 backward)
epileptic and choreic		6	0
non-viable	.	25	3
normal	.	10 (1?) 17.5%	50 81.9%

In such statements concerning human cases, it is difficult to determine whether non-viability, as well as other abnormalities, is due to inherent weakness of the offspring or to neglect on the part of parents.   Hence arises the chief value of confirmatory evidence obtained from animals, where conditions can be more fully known and controlled.

No alcohol was administered to Tipsy for a week previous to whelping, hence neglect of whelps due to anything approaching intoxication may be safely ruled out.   In fact, her care of the young seemed to be normal in every respect.

As to the whelps themselves, the cause of non-viability is not discoverable.   In the second litter the last puppy died on the seventh day after birth.   In the third litter none survived the third day.   The whelps were of normal size, but seemed to possess insufficient vigor to nourish themselves, although milk was abundant, and, to all appearances, of normal quality. The malformation in Topsy's whelp and in seven of Tipsy's was hair lip, generally on both sides.   One of Tipsy's whelps in the last litter, in addition to this, had both hind legs undeveloped below the heel.   Further than this, no malformation was discoverable in any organ, with the possible exception of the brain, a report of which must be deferred for the present.

Concerning power to resist an attack of distemper, the kennel affords the following evidence: During last spring

and early summer the extremely damp weather presented most favorable conditions for development of the disease. An epidemic occurred throughout the city in which the disease assumed a serious character. Sick dogs were not uncommon on the streets, and many died, the kennel from which part of my stock was obtained losing fifteen outright. This loss, occurring among dogs kept under what are usually considered " normal conditions," emphasizes the fact that practically all the value attaching to our results is to be placed to the account of the possession of adequate controls in the normal dogs, having been kept under precisely similar conditions of life.

In spite of all precautions, the distemper made its appearance in the kennel early in July. The kennel contained the following dogs:

Alcoholic.				Normal.
40 ccm.	alcohol daily,	Bum	. .	Nig, brothers from same litter.
" "	"	" Tipsy .	. .	Topsy II., sisters from same litter.
75 "	whiskey	" Frisky	} .	sisters from same litter.
150 "	wine	" Winnie		
200 "	beer	" Berry II.	.	Teeto } sisters.
				Minnehaha }

Distemper appeared as follows:

Winnie was taken sick July 6 and died July 8. Tipsy came down July 9, Frisky and Bum respectively the 12th and 13th. These all presented the characteristic symptoms: discharge from nose and eyes, cough, great prostration with loss of appetite and flesh. Among them, Frisky rallied promptly and was out of danger within a week. With Bum and Tipsy the disease took a more serious turn. Both were completely prostrated, refused all kinds of food. In both the cornea became cloudy and ulcerated, both dogs being temporarily blind. The ulcers were with great difficulty held in check by frequent cleansing and the application of eye washes. Strength had to be maintained by regularly drenching with fresh eggs and milk, but the first two weeks, with every effort, I had little hope of finding them alive from day to day. Food containing alcohol was persistently refused during the

whole time, and no attempt was made to force it upon them.
At the end of two weeks from beginning of attack both began
to gain strength, and from the third week recovered more
rapidly.

None of the other dogs exhibited any serious symptoms
of the disease.   They all, however, showed some disinclina-
tion to activity, were rather dumpish, and discharged some-
what from the eyes.   They did not lose appetite or fall off
in flesh.   Except for the discharge from the eyes they were
apparently about as well as ever.   If they had the distemper,
as seems probable, it was present in its mildest form.

Thus, with the exception of Berry II., who had taken less
than 9 ccm. of alcohol daily, all the alcoholic dogs exhibited
the disease in severe form.   All the normal dogs were affected
in a much less degree.   This sharp line of demarcation
between the alcoholic and normal animals as to severity of
attack is the main fact of interest.

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CONTENTS.

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At the meeting of January 18, 1898, the following papers were presented:

NORMAL SHAPE OF THE HUMAN FOOT,

with lantern illustrations.

E. H. BRADFORD.

The human foot is and has been so generally distorted by foot wear that the normal shape is not readily determined. Neither the anatomist who draws his conclusions from the dissecting-room, nor the surgeon who generalizes from his clinic, nor the artist who copies his models, can give us a normal standard.

A careful inspection of bare-footed adults who have never worn shoes, and a study of the feet in infants, enable the observer to determine the appearance of the foot unaffected by accidental conditions.

It will be observed that the metatarsals have a certain amount of flexibility and mobility (to an extent not easily determined) upward and downward at the articulation with the tarsus, and that the great toe, including its metatarsus, can be normally abor adducted from ten to twenty degrees, and the same is true of the fifth toe. Flexion and extension of all the phalanges is possible with a good deal of force (that of the great toe to the estimated strength of a pull of twenty

pounds) ; the abducting strength of the first toe and the adducting strength of the second can be estimated at a strength of five pounds.

In the different positions of the foot in standing and walking the metatarsals and toes are severally moved to aid in balance and in the support of weight.

A certain amount of rotation at the mediotarsal articulation is normal. The strength of the toes is greatest in barefooted individuals accustomed to use extensively the front of the foot in walking.

EXPERIMENTAL STUDIES ON THE INFLUENCE OF THE CENTRAL NERVOUS SYSTEM UPON THE DEVELOPMENT OF THE EMBRYO.

ALFRED SCHAPER.

It is a pretty general conception among embryologists, as well as physiologists, that the central nervous system from a very early embryonic period has a kind of leading or controlling morphogenetic influence upon the development of the entire embryonic body, and upon the differentiation of its organs; or, morphologically expressed, every structural change in the course of development within the central nervous system is accompanied or immediately followed by a certain corresponding alteration in the rest of the organism. This exceedingly fascinating conception appears at the first glance, indeed, very plausible and very satisfactory, especially when we consider how closely the function of every part of the animal body is, later, related to certain and indeed mostly very definite areas of the central organ.

However, thus far no absolute proofs for this theory of a morphogenetic correlation between the central nervous system and the entire embryonic body have been brought forward. On the contrary, many observations in human teratology, especially upon anencephalics and amyelitics, seem scarcely to be in agreement with this conception.

A renewed careful investigation upon this subject appeared to me desirable, and led me to undertake the following *experiments*, by which method of research alone a

satisfactory solution of this problem is, according to my opinion, obtainable.

As material for my experiments I selected frog larvæ, for several reasons: *first*, because they are easily procured in large quantities; *second*, they are readily raised, can be kept during development always under direct observation; and *third*, they have an enormous resistance to injuries and a great tendency towards the healing of wounds.

The aim of my experiments was to remove the entire central nervous system or certain parts of it by excision in very young larvæ where the neural tube had just closed, then to try to keep the larvæ alive, observing in the course of further development the consequences of the operation.

For this purpose I operated upon a considerable number of young tadpoles 5–6 mm. in length, by cutting off with a very sharp lancet a dorso-frontal segment of the head which (when the operation was successful) contained usually the entire brain, with the medulla oblongata, the anlage of the eyes, the olfactory and the auditory organs. The vegetative part of the head, especially the mouth cavity and the sucking disks, were always preserved.

After the operation, which was performed in small cardboard boxes with normal salt solution, the larvæ were placed in larger glass vessels with salt solution, containing, besides, some water plants. Here the brainless larvæ soon began to move again, and some even attached themselves, by means of their sucking disks, to the wall of the glass vessel or to the water plants. However, during the first, second, and third day the mortality of these larvæ was rather great; not seldom a half or more of such a set perished during this early period. Nevertheless, I succeeded, by repeated operations, in keeping a sufficient number of larvæ alive for several weeks, during which period they grew considerably and developed their outer shape, save certain defects in the head region, the direct results of the operation. As soon as the larvæ showed any signs of decreasing vitality they were preserved for microscopical examination.

From these larvæ now I wish particularly to describe one

which is highly instructive, and, as I think, of especial value for answering the question at issue. This larva was, when operated upon, 6 mm. long, the eyes were visible as minute dark spots, the mouth was not yet open. By the operation, except an insignificant part of the infundibulum, the entire brain, the medulla oblongata, the eyes, the smelling and the hearing organ, were removed, while both sucking disks and the gills remained. The larva recovered very soon from the shock of operation, and regained in a few hours its full mobility and reflex irritability. Its motions were strong, but decidedly atactic, in so far as it swam now on the back, now on the side, and again in the natural position. The operation wound was completely healed after two days. The head then appeared strongly pointed in front and somewhat constricted in the region of the gills. The mouth-opening, formed meanwhile, appeared as a sagittal cleft at the front of the head.

The larva developed for seven days, and gained in volume and size. At the end of the seventh day, however, its vitality seemed to decrease, and I transferred it therefore to the preserving fluid, together with a normal larva of the same breed, for comparison. At this time the operated larva measured 8 mm. in length, being only $\frac{1}{2}$ mm. behind the length of the normal larva.

Thereupon both larvæ were cut in transverse serial sections, and likewise another *normal* larva, which was preserved at that age in which the operation was performed on the other.

In describing and comparing the corresponding sections of these three larvæ I can, of course, not enter into details. I have to confine myself to calling your attention to certain principal points which are especially significant for our present purpose. Series A is made up of sections through a normal larva at the age at which our larva was operated upon.

Turning first our attention to this series, we notice that our larva at the time of operation was still in a very early stage of development. There is still a large amount of fully undifferentiated yolk, and those organs already present are found

only in their most primitive state. Comparing this series with series B, representing the state of things in a normal larva at that age at which the operated larva was killed, which means seven days older than the larva of series A, we see that during this period the development has made enormous progress. We can say, indeed, that the morphological differentiation of all the organs in their rough outlines is practically finished.

This proves that our brainless larva during the time of observation has continued to develop throughout a period in which normally the most significant and most revolutionary differentiations and morphological changes in the embryonic body take place. Hence the presumption appears justified that if there exists at all a developmental correlation between the different organs, and especially between the central nervous system and the entire embryonic body, then the elimination of certain parts, or, still more, of the entire central nervous system during such a period, must produce most striking and instructive consequences.

The microscopic examination of our operated larva, therefore, should be apt to throw some light upon these very fundamental processes of development.

Directing now our attention to the illustrations of series C (sections through the operated larva), we notice first the most curious defects and distortions in the area of the operation, in the region of the head, which become still more evident by a comparison of the corresponding sections of the normal larva in series B. *We see the head entirely brainless, without eyes, smelling and hearing organs. Nowhere a trace of regeneration of these organs is to be encountered. The healing of the operation wound was brought about by a proliferation of mesenchymal tissue, which was superficially covered by a layer of ectodermal epithelium.*

Going backward in our series, we find the first traces of a central nervous system at the posterior end of the medulla oblongata in the form of an irregular accumulation of cells, which only by their continuity with the posterior parts are proved to belong to the neural tube. Still farther back, in

the dorsal region of the embryo, we find finally *a spinal cord, at least in its morphological outlines. Higher magnification, however, reveals that its cellular constituents are in an extreme state of degeneration, and therefore any specific functional activity of the spinal cord is out of the question.*

These facts show that our larva lived, moved, and developed during seven days without brain and medulla, and during the second half of its life, even without a functional spinal cord, or, in other words, that we succeeded in producing by our experiment not only a living anencephalic, but at the same time an amyelitic frog larva.

Now we come to the principal point of our subject; that is, to ascertain in how far these defects of the central nervous system have influenced the organization of the entire body. Without entering into the many details which a careful microscopic study of the operated larva has furnished to us, I confine myself here to the brief and, as I think, rather surprising statement that *the absence of the central nervous system was practically of no demonstrable importance whatever in the differentiation of the embryo, at least during the period of our experiment.*

By looking over the sections of the operated larva and comparing them with the corresponding ones of the normal larva, it can be seen without difficulty that there are no fundamental differences in the organization of both. All the organs in the operated larva, except those the elements of which were directly removed by the operation, have not only developed in typical shape and correlative arrangement, but have also undergone a typical histogenetic differentiation. And still more, there have new organs and new tissues differentiated, which at the time of operation were not yet present, even in their most primitive form.

There are, indeed, some well-marked distortions of different organs in the head region, but these abnormalities have certainly nothing to do with the absence of the central nervous system; they are simply produced as direct mechanical consequences of the operation and the wound healing, together with a secondary contraction of the mesenchymal scar.

Altogether, we can say that every organ and every tissue has normally developed up to the very level of the scar.

Especial emphasis may be placed upon the fact that all the spinal ganglia, and even some of the cranial ganglia, were perfectly developed without showing the slightest traces of degeneration; that, besides, a peripheral nervous system was present, and the voluntary muscles showed the structure corresponding to that period of development.

What general conclusions, now, may be drawn from these experiments?

1. The central nervous system has, during a certain early period of development, no functional influence whatever upon the vital processes within the developing organism: it neither receives specific centripetal stimuli, nor sends any specific stimuli to the periphery; that is, it has neither sensory nor motor nor morphogenetic functions. In the same way the metabolism is independent of it; we saw the larva grow simultaneously with progressive resorption and assimilation of the yolk. All stimuli, therefore, outer as well as inner, must have met the individual cells *directly* during this period without transmission by means of a conducting nervous system.

2. The elimination of the entire brain with the foundations of the main sensory organs of the head, and the thereby produced alterations in normal topographical correlation to neighboring organs, had no demonstrable influence either upon the further development of the organs, or upon that of the entire organism. All processes of growth and differentiation took place according to typical principles.

3. According to these phenomena the development of the individual parts of an organism during a certain embryonic period takes place according to the so-called "*principle of auto-differentiation;*" which means that the power of developing in a definite direction, and into a definite end product, is from a very early period potentially inherent to the smallest parts of the germ. A correlative development of neighboring organs, or a functional control of the development of the entire organism by a central organ, is nowhere

to be proved.   It is, therefore, as a kind of " *mosaic-work* " that the animal body is built up.

In applying these results obtained by experiment to *human teratology* we shall find them, I think, of some use for a rational comprehension of certain monstrosities which have been thus far more or less a puzzle to all observers.   Here I have especially in mind some cases of complete anencephaly and amyely.   There are cases described in which, in spite of the absence of the entire central nervous system, no fundamental disturbances in the development of the rest of the body were to be encountered.   Such cases show an astonishing resemblance to our frog larva, and I think there can be no doubt that the processes which have led to such a result have been in both cases fundamentally the same.

Even the human body, during a long period of intrauterine life, cannot be considered as a functional unity; its development during this time is likewise subject to the law of *auto-differentiation* of its components, which differentiate in a definite direction without any functional or local correlations.

However, we know that after birth practically no part of the central nervous system can be removed without stopping the function of an organ, or a complex of those which are functionally related to the parts of the central organ removed; and still more, we know that these organs undergo a more or less rapid degeneration, ending in complete atrophy.   That a human body can live without a central nervous system for a long time after birth is of course out of the question.

How can we bring the results gained by our experiments and the experiences of teratology into harmony with these facts?   A recent theory of *Wilhelm Roux*, likewise based upon experiments, may give the desired explanation.   *Roux* divides the development of every organism into an early period of what he calls " *organogenetic development*," and a later period of " *functional development*."   During the first period the different organs develop by means of an inherited endogenous energy in a definite direction without influence from outer stimuli, that is, by auto-differentiation; during the second period, however, the gradually developed

specific function of the individual organ, as well as the coöperative function of all the organs of the body, are the main stimuli for further growth and development, and are indispensable for the normal life of the single organs, as well as of the entire organism.

It is, therefore, during that first period of "organogenetic development" that our frog larva, as well as the human embryo, can develop in the absence of a central nervous system, without fundamental disturbances. However, with the moment they enter the second phase of functional development, that is, when the different organs develop their specific functions, the conditions of normal development become entirely changed. *It is now that the functional coöperation of all the organs of the body is absolutely necessary for further development, growth, and life in general, and therefore the absence of an important organ, and especially of the central nervous system, must be fatal and lead to the death of the organism.* This critical moment varies for different animals greatly. In mammals and in man it seems to lie near the term of birth.

STERILIZATION OF SUTURES.

CHARLES HARRINGTON.

Dr. Charles Harrington described a series of experiments conducted by him on the sterilization of catgut sutures by means of formaldehyde gas. All sizes of catgut were thoroughly sterilized, but under certain conditions they lost both strength and flexibility. Under other conditions only the smaller sizes were injuriously affected. A new series under new conditions is well under way, and thus far gives excellent results. When this is completed the detailed results obtained from all the work will be presented for publication.

DISTRIBUTION OF SUPERIOR MESENTERIC ARTERY.

T. DWIGHT.

Abstract of a paper to be published in the proceedings of the Association of American Anatomists.

It is remarkable that general descriptions of the vessels to the small intestine from this artery should exaggerate the

number of arterial arches that they form and at the same time ignore the system of straight vessels, without anastomoses between each other, that go to the gut. These are long in the upper part of the intestine and diminish in size lower down. At the lower end, as the vessels get smaller, the complexity of the system of arches increases. Near the end of the ileum a vessel runs parallel to the gut, and sometimes very near it.

DIPHTHERIA OF THE SKIN OF THE NECK.

W. H. PRESCOTT.

J. K., 9 years. Well developed and nourished; diphtheria. September 23 went to Boston City Hospital, South Department. Discharged October 22. Well until November 17, when had another attack and remained at the Boston City Hospital, South Department, ten days. December 7 a slight swelling was noticed in one of the glands in left side of neck; poultice; three blisters appeared (over swelling), each 2 cm. long. These broke, but the epidermis was not rubbed off. A dirty-grayish membrane appeared (under the dead epidermis), which spread, forming a sore the size of a ten-cent piece, with irregular edges. This was treated at first with peroxide of hydrogen 3% (Marchand's), but as it caused severe pain corrosive sublimate wash (1 : 3000) was substituted. The sore was treated three times a day with this solution, and then cloths wet in 1 : 5000 corrosive sublimate were applied as a dressing. The lesion was slow in healing, and was not entirely closed until January 10. There were slight constitutional symptoms — headache, slight fever (100.5°), *malaise* for one day; otherwise the child appeared and acted perfectly well.

Cultures:

December 4, throat negative.
" 7, throat and nose negative.
" 11, " " " "
" 18, sore positive.
" 24, " "
January 7, sore sterile.

There were cultures also taken from the nose and throat which were negative when there were diphtheria bacilli in the culture from the sore.

I am indebted to Dr. C. M. Smith for the cultures which were made.

"VARIOMETER" OF VON HEFNER–ALBENECK,

made by Warmbrunn, Quilitz & Co., of Berlin.

H. P. BOWDITCH.

This instrument consists of a bottle filled with air and surrounded by felt. The interior communicates with the external air by two glass tubes passing through a rubber stopper. One of these tubes is drawn out to a capillary opening, while the other, which has a diameter of $\frac{1}{2}$ mm., is bent in such a way as to hold a drop of petroleum in a position which is nearly horizontal, but with a slight concavity directed upward.

Slight changes in the pressure of the surrounding air, if they occur slowly, produce through the capillary tube a corresponding change in the interior of the bottle, and there is no movement of the drop of petroleum; but if the change is so sudden as to give insufficient time for this equalization of pressure, the drop of petroleum is driven in one direction or the other, according as the change is positive or negative.

The slight changes of pressure in the air of a room caused by opening and shutting a door are distinctly recorded by this instrument.

PRELIMINARY NOTE ON THE ACTION OF SALINE CATHARTICS.

By GEORGE B. WALLACE AND ARTHUR R. CUSHNY.

From the Pharmacological Laboratory, University of Michigan.

In his well-known article on intestinal absorption, Heidenhain asserts that solutions of sodium sulphate are not absorbed as rapidly as isotonic solutions of sodium chloride, and explains this by supposing that the sulphate exercises some deleterious effect on the epithelium of the intestine, which

thus becomes more or less incapable of carrying out the function of absorption. That part of the absorption which is a purely physical process proceeds as rapidly from solutions of sodium sulphate as of sodium chloride. He found that the fluoride has a similar effect in slowing absorption.

The saline cathartics are by many believed to have the effect of delaying absorption, but the subject has scarcely been touched upon since the laws of osmotic action have been more clearly recognized. We have, therefore, investigated the behavior of isotonic solutions of the ordinary saline cathartics in order to find whether they all resembled sodium sulphate, and have further extended our inquiry over a considerable number of salts with the hope of being able to define more closely the difference between the ordinary non-aperient salts and the saline cathartics.

Our method was to contrast the effects of isotonic solutions of different salts. A solution of sodium chloride of about 1 per cent. was formed, and its freezing point in Beckmann's apparatus was found to be $0.615°$. This was taken as the standard, and the other salts were dissolved and diluted until the freezing point of the solution was approximately $0.615°$ below that of distilled water. This exceedingly laborious method we found the only one which gave satisfactory results. The greatest deviation in the depression of the freezing point in our solutions did not exceed $0.04°$, *i.e.*, Δ varied from 0.57 to 0.64, and sodium choride solutions within these limits were absorbed equally rapidly, so that for the purposes of our experiments, all the solutions may be looked upon as isotonic.

Cats and dogs were used in the experiments, rabbits having been found to give unsatisfactory results. The cats were anesthetized with urethane and morphine; the dogs with morphine, and ether or chloroform if necessary. Food was usually withheld from the animals for twenty-four to forty-eight hours before the experiment, so that the small intestine was practically empty when opened.

The method employed consisted in opening the abdominal cavity by a median incision, tying off several loops of small

intestine, and injecting into the loops the solutions to be tested, using one loop, usually containing sodium chloride, as a control. The solutions were left in the loops for a certain time, and then the residue was taken out and measured. In the cat two loops were usually used, of about eighteen inches each in length; in the dog three and often four loops of twelve inches each, so that several solutions could be tested at the same time. The loops were washed with a solution of normal salt, previous to the experiment, in a number of cases, but as the washing involved a certain amount of handling, which was somewhat injurious to the intestinal action, and since usually the intestine contained but little if any fecal matter, owing to previous withdrawal of food, this washing was not done in all the experiments.

The solutions having been warmed to body temperature, from 15 to 25 c.c. were injected into each loop and allowed to remain there for thirty minutes, since the control solution would be practically all absorbed in that time. Each loop was then emptied of its contents by gently stripping it, and the amount of the residue compared with that recovered from the control loop. A loop could be used in this manner three or four times.

Several experiments were made with each salt, and the results showed a remarkable uniformity. The saline cathartics — sodium and magnesium sulphate, sodium, potassium, and magnesium citrate, sodium and potassium tartrate, sodium di-hydric and mono-hydric phosphate solutions — were all absorbed much more slowly than isotonic sodium chloride solution.

On looking over the list of saline cathartics the fact is at once observed that the acid and not the basic constituent of the salt is the determining factor in the action, and we there-fore confined our attention later to the sodium salts only. Of these we have examined the formate, acetate, propionate, butyrate, valerate, capronate, and caprylate, the oxalate and malonate, the malate citrate, tartrate, lactate, ortho- and para-phthalate, the chloride, sulphate, and the mono- and di-hydric phosphates. Heidenhain examined further the flu-

oride. As regards their absorption from the intestine, these
salts may be divided into two sharply differentiated classes,
those resembling the chloride, and those absorbed more
slowly. The following fall into the first class — the formate,
acetate, propionate, butyrate, valerate, capronate, lactate, and
chloride, while the caprylate oxalate, malonate, malate, citrate,
tartrate, both phthalates, sulphate, phosphates, and fluoride
are very much more slowly absorbed. In addition, these
latter exercise a lasting effect on the intestinal epithelium, for
a solution of the chloride placed in the loop subsequently
is not so rapidly absorbed as one placed in a control loop.
The salts of this second group are not, however, all equally
poisonous to the epithelium, for the oxalate is much less
rapidly absorbed than any of the others.

In attempting to find an explanation for the different
behavior of these salts, we were struck by the fact that all of
the second group form insoluble precipitates with lime water,
the oxalates again being the most powerful precipitant, while
the salts of the first group remain in solution. This is the
only point possessed by all the salts of the second group, and
by none of those of the first, which we have been able to
find. The question arises, therefore, whether the insolubility
of the calcium compounds bears any relation to the slowed
absorption.

The importance of calcium in various functions of the
organism has been shown already in the coagulation of
blood and milk, in the contraction of the frog's heart, and
of ordinary muscle. Howell and his pupils are inclined to
attribute the action of the oxalate on the heart to its pre-
cipitating the calcium. The formation of insoluble calcium
compounds might be supposed to have the same effect on
the intestinal epithelium as the withdrawal of lime salts from
the nutrient fluids of the heart, the changes of the living
protoplasm being retarded while those processes which are
independent of the life of the cell remain unaffected. We
think, then, that the uniformity of our results gives some
grounds for believing that the saline cathartics and various
other salts retard the intestinal absorption by forming insolu-

ble compounds with the calcium salts of the bowel wall and thus lessening its activity, although it is, of course, possible that all of these salts may have a specific action on the bowel wall, quite apart from the precipitation of calcium. We hope to find some support for this explanation of the action of the saline cathartics in our further work on the subject, and intend to commence at once a series of comparisons of the effects of these salts on other organs — the heart and kidney.

CEREBRO–SPINAL MENINGITIS AND ITS RELATION TO OTHER FORMS OF MENINGITIS.

By Drs. W. T. Councilman, F. B. Mallory, and J. H. Wright.

Abstract of report to Massachusetts State Board of Health.

The authors investigated one hundred and eleven cases of epidemic cerebro-spinal meningitis which occurred in the Boston City Hospital, the Massachusetts General Hospital, and the Children's Hospital, between June, 1896, and Oct. 1, 1897.

At the time of the appearance of the first in June there had been no cases of this form of meningitis in these hospitals for a number of years. The first occurred in June, 1896, one in the following September, and three in December. In 1897 there was one case in January; ten in February; twenty-three in March; twenty-nine in April; twenty-one in May; fourteen in June; seven in July, and three in September.

The disease has been epidemic in Boston a number of times. Its first appearance in Massachusetts was in 1806, and it prevailed in the New England States until 1816. There was another outbreak between 1864 and 1866, and still another in 1874.

Children and young adults were most commonly attacked. A table of ages agrees almost exactly with a table of ages of one hundred and eleven cases given by Leichtenstern in the epidemic in Cologne in 1885. A map of the city giving the distribution of the cases shows them to be pretty well scattered, there being only two localities where they were espe-

cially numerous. Several times two members of the same family were attacked.

Post-mortem examinations were made in thirty-five cases, and the diplococcus intracellularis meningitidis of Weichselbaum was found in cultures, or on cover-slip examination of the exudation, or in microscopic sections, in all but four. Most frequently they were found in all three methods of examination. In one of the four in which the cultures were negative at the post-mortem examination, the organisms had previously been found in the fluid withdrawn by spinal puncture. Two of the others were chronic, and no acute lesions were found. The other negative case was chronic with a mixed infection of tuberculosis.

The best medium for the growth of the organisms was found to be Lœffler's blood serum mixture. Several times considerable difficulty was found in obtaining a growth. Very many of the bacteria appeared to be dead, or at least they would not grow. As showing the difficulty in growing the organism in cultures made from the meninges at post-mortem examination, in one case ten tubes were inoculated with the exudation from the brain and six from the cord. Cover-slip examination showed abundant diplococci in the cells. Only two of the cultures from the brain and one from the cord were positive, a single colony being found in each tube.

The diplococcus corresponds closely with the description given by Weichselbaum. The authors were not able to confirm the statement of Jäger that it has a tendency to grow in streptococcus form. There was considerable irregularity in staining, some of the bacteria being brightly stained, others more faintly. Sometimes this difference was seen in a single pair, one being more brightly stained than the other.

The diplococci were found almost exclusively within the cells, and not in the nuclei. The numbers in the cells varied from a single pair to so many that the nuclei were obscured. They were found only in connection with the lesions of the disease. So far as could be learned from cultures of the blood, liver, spleen, and kidneys, the organism never gave rise to septicemia.

Mixed infections with other bacteria were not uncommon. Pneumococci were found seven times as the mixed infection and Friedländer's bacillus was found once. Terminal infections with streptococci and staphylococci were occasionally seen.

The results of inoculation were confirmatory of those of previous investigators. The organism has very feeble pathogenic powers when injected into the pleural and peritoneal cavities of rabbits and guinea pigs, and produced no results when injected subcutaneously. In a small percentage of cases death was produced in twenty-four to forty-eight hours, and slight fibrino-purulent exudation was found on the serous surface. Typical cerebro-spinal meningitis was produced in a goat by inoculating directly into the spinal canal. The animal died within twelve hours, and at post-mortem examination a slight fibrino-purulent exudation was present in the meninges of both the brain and the cord.

Lumbar puncture was performed in fifty-five cases. In the fluid obtained diplococci were found on microscopic examination or in cultures in thirty-eight. In seventeen they were absent. The duration of time from the onset of the disease before spinal puncture was made was seven days in the positive cases and seventeen days in the negative. The earlier the spinal puncture the more sure are positive results obtained in cultures. The same difficulty in growing the organism was found as in the cultures made at the post-mortem examination.

The character of fluid obtained by spinal puncture varied greatly. Sometimes, even when diplococci were found in it, it was almost clear, showing a slight turbidity when held against a dark background. Most often, where the puncture was made early in the disease, the fluid was turbid, in some almost like pus, and in twenty-four hours a large sediment formed at the bottom of the tube. In one case in which the disease clinically showed a marked intermittent type, spinal puncture was made before, during, and after an exacerbation. Clear fluid without diplococci was obtained

before and after the exacerbation.   During the exacerbation the fluid was more cloudy and contained diplococci.   No ill effects were seen from spinal puncture.

The results of the histological examination of the meninges showed in the most acute cases a purulent exudation, with very little fibrin.   In the most chronic there was great thickening of the meninges, with small masses of degenerated cells marking the remains of a former purulent exudation. In cases dying in from four to ten days after the onset there was a great deal of fibrin mixed with the pus.   A characteristic feature of the process was the presence of large phagocytic cells mixed with the pus cells.   These cells are more numerous in epidemic cerebro-spinal meningitis than in other forms of meningitis.   The tissue of the brain itself was affected a number of times.   Macroscopically, areas of softening and small foci of multiple hemorrhages were found. Microscopically there was some degree of leucocytic infiltration of the cortex and a marked increase in the neuroglia cells.   Nuclear figures were found in the neuroglia cells of the brain and in the neuroglia of the optic and olfactory nerve.   No definite abscesses were found in the brain.   The exudation followed along the course of the cerebral nerves, which were almost invariably affected.   The nerves most affected were the second, fifth, and the eighth.   The Gasserian Ganglion was examined in several cases, and was always found in a state of acute inflammation.   Pus cells were found in the sheath of the nerve between the fibres and between the ganglion cells, many of which by the Nissl stain showed marked degeneration.   In several cases a choroidoiritis was produced by direct extension of the process along the optic nerve into the eye.   Once diplococci were traced from the nerve sheath of the optic nerve directly into the eye. The meninges of the cord were always affected.   Sometimes the meningitis was more marked in the cord than in the brain.   In the cord the greatest amount of exudation was found in the lower and posterior part.

In eight of the thirty-eight cases on which post-mortem examinations were made, pneumonia due to the diplococcus

intracellularis was found. This took the form of foci of consolidation which microscopically appeared as a distinctly purulent inflammation, there being but little fibrin present in the exudation, although in places there was a great deal of hemorrhage. The diplococci were present in the purulent exudation in enormous numbers. These lung lesions were found in both the acute and the chronic cases. Acute lung lesions were found in one of seventy-four days' duration, when the lesions in the meninges could be regarded as healed. In another instance they were present in a case in which the disease appeared to be only of two days' duration. In two there was typical croupous pneumonia, pneumococci being found in the lungs, and the diplococcus intracellularis in the lesions of the brain and cord.

Sections of the nerves and cord stained by Marchi's method showed extensive degeneration of the fibres.

The authors also investigated a number of cases of pneumococcus, streptococcus, and other forms of meningitis. Of ten cases of pneumococcus meningitis two were found to be primary. The histological character of the lesions in the pneumococcus and streptococcus meningitis differ slightly from those in the epidemic form.

SPECIAL NOTICE.

The Journal will be published *immediately* after the meetings of the Society, and will contain authors' abstracts of the papers presented, when these papers are not given in full.

By general consent of the Heads of Departments it will contain full abstracts of experimental work carried on in the following institutions: the Medical School of Harvard University, the Experiment Laboratories of the Massachusetts General and the Boston City Hospitals, the Physiological and Biological Departments of the Massachusetts Institute of Technology, Clark University, and the Anatomical Laboratory of Brown University.

Papers and abstracts of papers upon subjects connected with the Medical Sciences will be welcomed from persons not members of the Society, and if approved by the Council will be presented at the meetings, and will be given a place in the Journal.

When desired, the insertion of papers, if in abstract, will be accompanied by a note indicating the place where they may be found in full. Fifty reprints will be furnished free to authors if the desire for them be expressed on the manuscript.

Subscribers to the Journal are invited to attend the meetings of the Society; the next will occur February 15, at the Harvard Medical School, at 8 P.M.

All communications should be addressed to the Editor,

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JOURNAL

OF THE

Boston Society of Medical Sciences

CONTENTS.

At the meeting of February 15, 1898, the following com-
munications were made:

THE MOVEMENTS OF THE STOMACH, STUDIED BY MEANS OF THE RÖNTGEN RAYS.

W. B. CANNON.

The Method. — The method, which was suggested by Dr.
H. P. Bowditch, was that of mixing with the food subnitrate
of bismuth, and observing the movements of the stomach and
its contents by means of the Röntgen rays and a fluorescent
screen.   The cat was chosen for the subject of the research,
and after being fed, was tied, back downward, on a stretcher
under which the vacuum tube was placed.   The shape of the
shadow of the stomach, thus thrown on a fluorescent screen,
is shown in the first of the accompanying figures.   (See
Fig. 1.)

The Parts of the Stomach. — Physiologically, the stomach
is divisible into a cardiac part or fundus, the muscles of which
show tonic contraction; and a pyloric part, the muscles of
which contract rhythmically.   At the sharp bend in the
pyloric part is a muscular thickening, the sphincter antri
pylori, dividing the pyloric part into the antrum, lying
towards the pylorus, and the preantral portion, or middle
region of the stomach, lying towards the fundus.

The Movements of the Pyloric Portion. — Soon after food
is ingested slight constrictions appear at the beginning of
the pyloric portion, and pressing deeper into the greater
curvature, course slowly towards the pyloric end. As new
regions enter into contraction, the fibres just previously
contracted relax, so that there is a true moving wave with a
trough between two crests. About thirty-six seconds elapse
while a wave is passing upon the middle of the stomach to
the pylorus. The waves recur every ten seconds; conse-
quently, when a wave is beginning, several others are running
in order before it. The total number of waves which passed
over the antrum during the seven hours a cat was digesting
a meal of soft bread was about 2,600.

The Action of the Pylorus. — The pylorus does not open
for ten or fifteen minutes after the first constriction is seen;
and after it once relaxes it does not relax again at the
approach of every wave, but only at irregular intervals.
When a hard bit of food reaches the pylorus the sphincter
closes tightly and opens less frequently than when the food
is soft.

The Action of the Cardiac Portion. — The action of the
cardiac portion will be seen by comparing the accompanying
figures, which show the appearance the stomach presents
every half hour, from the time of eating until the stomach is
empty. These outlines were made by tracing the form of
the stomach on tissue-paper laid on the fluorescent screen.
A comparison of the figures shows that as digestion pro-
ceeds, the antrum appears gradually to elongate and acquire
greater capacity, and that the constrictions make deeper
indentations in it. Later it becomes smaller again.

The middle region is first to decrease in size. The waves
passing over it gradually press some of the contents into the
antrum, and thence into the intestines. As the process con-
tinues the middle region comes to have the shape of a tube
with the rounded fundus at one end and the active antrum at
the other. Along the tube shallow constrictions pass in
monotonous succession. Now the fundus contracts and
squeezes its contents into the tubular portion. This action,

accompanied by a slight shortening of the tube, goes on till the shadow cast by the fundus contents is almost wholly obliterated. The constriction-waves press the food onward
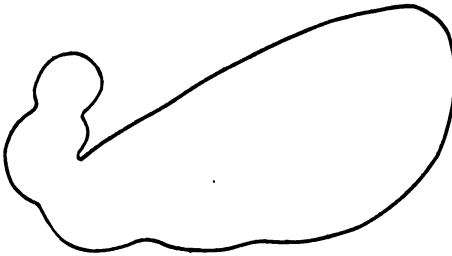
Fig. 1. **11.00 a.m.**
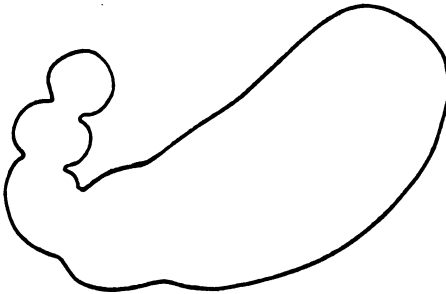
Fig. 2. **11.30 a.m.**
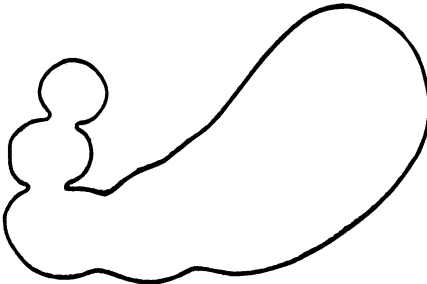
Fig. 3. **12.00 m.**

Movements of stomach of cat in digestion, as traced on fluorescent screen by Röntgen rays. Half actual size.

along the tube as fast as they receive it from the contracting fundus; and when the fundus is emptied they sweep the contents of the tube into the antrum.   Here the deeper waves

complete the operation, and at last, with the exception of a
trace of food in the fundus, nothing is to be seen in the
stomach at all.
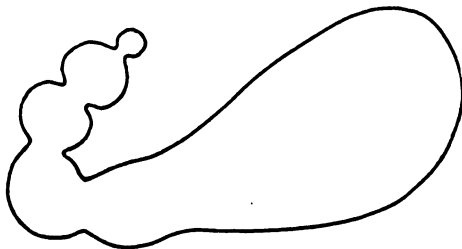
Fig. 4.   **12.30 p.m.**
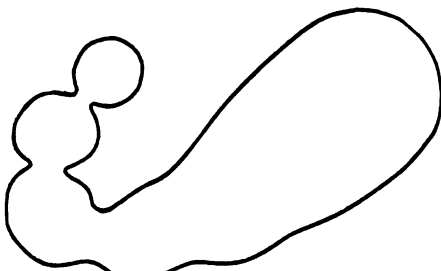
Fig. 5.   **1.00 p.m.**
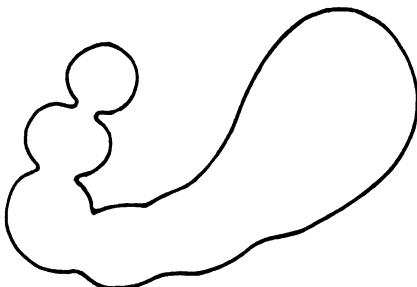
Fig. 6.   **1.30 p.m.**

The Effects of the Movements on the Food. — Beaumont
and Brinton have declared that, for the purpose of mixing the
food with the gastric juice, there is a complete circulation of
the food in the stomach.   The absence of constrictions in
the fundus makes their theories improbable; and experi-
ment disproves their suppositions.   Little pellets of starch

paste, containing a relatively large amount of bismuth subni-
trate, are conspicuously dark in a dimly outlined stomach.
When a constriction approaches, the ball moves forward, but
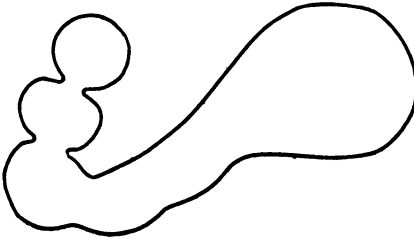
Fig. 7. **2.00 p.m.**
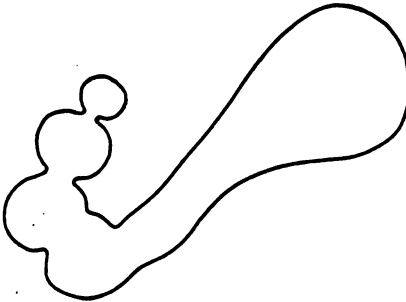
Fig. 8. **2.30 p.m.**
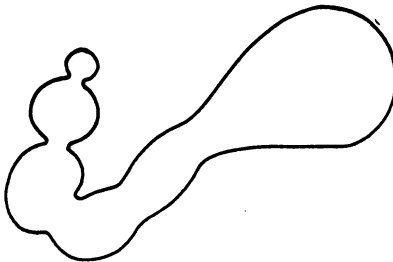
Fig. 9. **3.00 p.m.**

not so rapidly as the wave. When the wave overtakes it,
the ball finds escape from pressure through the constricted
ring and moves backwards. With the passing of the next
wave this movement is repeated, and as the waves recur the
ball is seen to be making progress — an oscillating progress
— towards the pylorus; for it goes forward each time a little

farther than it retreats. On its way a piece of food is moved
back and forth by more than a half-hundred constrictions.

The closed pylorus makes the antrum a blind elastic pouch.
Near the end of the antrum the constrictions are deep and the
rings are small; consequently, food is squirted back through
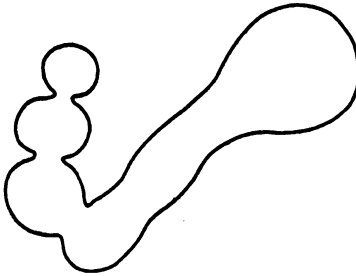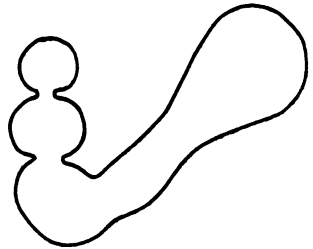
Fig. 10. 3.30 p.m.   Fig. 11. 4.00 p.m.
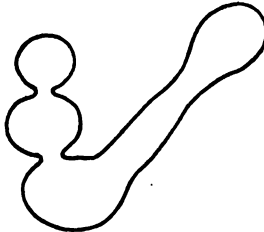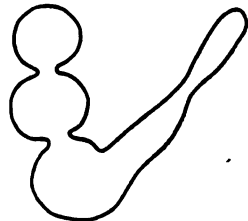
Fig 12. 4.30 p.m.   Fig. 13. 5.00 p.m.
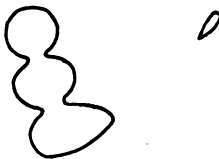
Fig. 14. 5.30 p.m.   Fig. 15. 6.00 p.m.

them with considerable violence. The pylorus opens less fre-
quently after a hard morsel comes to it. In such a case the
waves squeeze the hard morsel, and the soft food about it, up
to the sphincter, only to have the whole mass shoot back,
-sometimes half-way along the antrum. This process is
repeated again and again. Finally, the soft food is allowed
to pass, but the hard body remains to undergo a tireless
rubbing.

Although these observations do not sustain the theories of mixing currents, they nevertheless show that the pyloric portion is an admirable device for bringing the food under the influence of the glandular secretions; for when a constriction occurs, the secreting surface is brought close around the food lying within the ring in the axis of the stomach. Now, as this constriction passes on, fresh areas of glandular tissue are continuously pressed in around the narrow orifice. And also, as the constriction passes on, a thin stream of gastric contents is being forced back through the orifice and thus past the mouths of the glands. Thus every part of the secreting surface of the pyloric portion is brought near to every bit of food before the latter leaves the stomach, a half-hundred times or more, as evidenced by the moving ball.

During digestion, food in the cardiac portion manifests no signs of currents. Pellets keep their relative positions in the fundus till the fundus begins to contract. And when a meal is fed in layers of food, with and without bismuth subnitrate, the stratification disappears in the pyloric part within ten minutes, but persists in the fundus for more than an hour.

Salivary Digestion in the Stomach. — Absence of movement in the fundus would seem to give the food there little opportunity to become mixed with the gastric juice, and thus to undergo peptic digestion. A cat, given a slightly alkaline meal, was killed an hour and a half after eating. In the fundus, food near the periphery was acid; food 2 cm. from the gastric wall showed the original alkalinity; in the antrum and middle region, food at all depths was strongly acid. The nutriment, therefore, if well chewed, and thus mixed with saliva, can undergo salivary digestion in the fundus for a considerable period, without interference by the acid gastric juices.

The Action of the Stomach in Vomiting. — When a cat is given apomorphine, the fundus wall at first relaxes, then twitches irregularly; soon a deep constriction starts, about 3 cm. below the cardia, and, deepening, moves towards the pylorus. It tightens at the sphincter antri pylori, and holds fast, while a wave of contraction sweeps over the antrum.

As a second wave follows, the sphincter antri pylori relaxes slightly, to tighten again when the wave reaches it. Perhaps a dozen such waves pass, and then a firm contraction of the sphincter antri pylori divides the gastric cavity into two parts. A flattening of the diaphragm and a quick jerk of the abdominal muscles, accompanied by the opening of the cardia, now force the fundus contents into the esophagus.

The constrictions which precede vomiting are almost exactly the same as those described by Beaumont and Hofmeister and Schütz, as the normal gastric actions. Since, however, their observations were made on the unnaturally stimulated stomach, it seems reasonable to suppose that they did not see the normal movements of the organ.

The Inhibition of the Stomach Movements. — Early in the research, it was noticed that when a cat was restless on the holder, the movements of the stomach failed to appear. Later, when a cat, in which the movements were going on regularly, changed from her quiet state, and showed signs of anxiety, immediately the movements ceased. On petting her, she began to purr, and the movements commenced again. Since no amount of passive movement of the cat would stop the waves, the inhibition was probably due to nervous influence.

By holding a cat's breath until the first signs of distress are evident, the stomach-movements can be stopped at the observer's will. This has been done repeatedly on many cats, and invariably the sames urprising sensitiveness to nervous conditions has manifested itself.

INVESTIGATION INTO THE ACTION OF THE VAGUS NERVE, AND ITS SIGNIFICANCE FOR OUR UNDERSTANDING OF THE NORMAL HEART–BEAT.

L. J. J. MUSKENS.

Since I came to Boston, last September, I have continued a study of the action of the vagus upon the heart, which I had begun more than two years ago in Utrecht, Holland. Carrying on at that time an investigation of the centripetal nerves of the vertebral heart, I observed a rather peculiar

and striking fact. It is well known that stimulation of the tenth cranial or pneumo-gastric nerve causes standstill of the heart. This most remarkable effect has always fascinated physiologists as an instance of a nerve which *depresses* the action of its peripheral organ. This is a striking contrast with what we usually see, viz., that stimulation of an efferent nerve evokes activity of its peripheral organ. Now, producing a reflex stimulation of this same nerve of the frog, I demonstrated that often during this standstill, which is generally believed to be a complete one, very slight movements of deeper parts of the heart could be seen. The more carefully I examined, the more I could see this phenomenon. Subsequent study of the literature of the subject showed that this was not altogether new, especially since in Gaskell's work with the tortoises similar movements were seen. At that time the pressure of neurological, clinical, and anatomical work prevented me from following out this interesting study. In this well-equipped physiological laboratory I have had an excellent opportunity to do so.

Permit me to ask your attention to the experimental method which I adopted:

[A demonstration of the suspension of the different parts of the heart, after the principle of Engelmann, and also of the new improved manner of vagus stimulation, followed.]

Without trying to explain in detail the advantages of this method of stimulation of the vagus, I will only refer to Tarchanow's statement, that in the customary method of stimulation of the vagus he had to wait two or three hours before the nerve had recovered from the operation itself. In stimulating by my method there is absolutely no question of injury to the nerve.

As it seems impracticable to explain here all the results of this investigation, I will call your attention merely to that detail which seems to me to have importance for our knowledge of the normal heart-beat.

Gaskell in 1883 discovered the important fact that in the tortoise the coördination of the movements of the different parts of the heart can be abolished, owing to the diminution of the conducting power between sinus and auricle, and

between auricle and ventricle.   McWilliams   and other English and American investigators described analogous phenomena in the heart of fishes and mammals.   Engelmann found recently that in the isolated sinus of the frog the co-ordination may be lost.   My work with the Dutch, but still more with the large American frogs and turtles has convinced me that dissociation of the different parts of the heart under nerve-influence, that is, under physiological conditions, occurs much more frequently than might have been suspected. Moreover, not only are the three parts of the heart seen to be dissociated from each other, but this process can be seen under favorable conditions also between the different parts of the most important cavity of the heart, viz., the sinus and the large veins.   The dissociation gradually gives place to the normal coördination, as the influence of the nerve-stimu-lation disappears.

Whatever views may be held regarding this fact of the dissociation, it must be admitted that we cannot look upon the three cavities of the heart as physiological unities, but rather as a system of contractile parts, placed in communi-cation by the conducting power of the heart.   The process of dissociation under nerve-influence we could follow till the contractions become invisible.   It seems from my experi-ments highly improbable that this dissociation should stop here.   The curves, which could be got by suspending two parts of the same large vein of pseudemys elegans during vagus stimulation, are of importance for this question.   If these results may seem to you to complicate the problem of the normal heart-beat, I hope to convince you soon that the contrary may be the case.

Summarizing the results, they seem to me to lead inevitably to the conclusion that the influence of the vagus upon the conducting power, as well as the importance of the conducting power itself for the normal heart-beat, have been largely un-derestimated.   After the vagus stimulation the returning conducting power enables the peristaltic contraction to spread gradually over the whole heart, from slight, scarcely visible contractions of a small portion of the sinus.   We know from

the work of Engelmann that every passing contraction wave also diminishes the conducting power of the heart substance. The conducting power is restored rapidly after the contraction wave has passed over; in the case of the vagus action the conducting power generally is restored more slowly. The suspicion forces itself upon us that the normal heart-beat originates in both cases similarly.

We come therefore to the following conception of the heart movements. As the sinus is practically the leading part of the heart in regard to the rhythm, I will especially describe the manner in which the rhythmical contractions of this part of the heart may be accomplished.

In the different portions of the heart-root* continual stimulations are produced in the same manner as in the ciliary epithelium. In one or at least a few spots these stimuli are produced with far greater rapidity than in the rest of the heart-root. It is there, also, that the actual contraction first takes place. If the conducting power is sufficiently restored after the foregoing contraction, the contraction may pass over more and more of the sinus, and finally to the auricle and ventricle.

In the normally-beating, well-nourished heart this process is accomplished rapidly and at once. The same process during the vagus action is blocked in the heart-root itself, or between sinus and auricle, or between auricle and ventricle. The normal heart-beat is here only gradually restored.

This process does not differ very much from the second of the two processes, in which the normal heart-beat, according to Engelmann, may originate. It may be mentioned that Engelmann reached these two suppositions, working along quite other lines.

Johannes Müller compared the rhythm of the heart to the rhythm with which air-bubbles are pressed out of a tube under water. If this comparison may be admitted, then in the case of the heart it may be the limited conducting power, which acts like the resistance of the water in the above

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* Under heart-root may be understood the venous sinus and the large veins which open in it.

experiment.   Both transform a continuous action into
rhythmical discharges.

ON THE CLASSIFICATION OF THE LEUCOCYTES OF BLOOD FOR PURPOSES OF CLINICAL WORK.

HENRY F. HEWES.

The leucocytes of human blood possess certain differen-
tial characteristics, which allow of their classification into
several varieties.

By utilizing a less or greater number of these characteris-
tics, different observers have distinguished from three to ten
varieties among the leucocytes of normal blood.   Thus the
classification used by Rieder has three, Hardy and Kant-
hack's five, Cabot's five, Ehrlich's five, Tschrstowstch's
seven, Uskow's ten.

The classifications cited, as indeed all which are in general
use in the clinical examination of the blood, possess in com-
mon two characteristics which greatly impair their usefulness
for scientific or practical work.

These objectionable features are:

(1.)   The use of several differential principles in the sep-
aration of the different varieties of leucocytes, as, for in-
stance, selective color affinity, morphology, and size.

(2.)   The employment in the classifications of a nomen-
clature composed of terms not in all cases purely descriptive,
or having a definite basis for their application.   The funda-
mental principle of differentiation in all classifications which
are used generally for clinical work at the present time is
that of the staining reaction of the leucocytes.   Classifica-
tions utilizing this principle have superseded, as more use-
ful, the older morphological ones, and the work on the
clinical examination of the blood has been done on these
lines.   But in none of these in which this essential principle
is used is it the single basis of differentiation.   In all,
additional principles, such as the morphology, size, and
theory of development of the leucocytes, are used as charac-
teristics for differentiation.   And it is, as I have said, in this
basing of the classifications upon several differential prin-

ciples that their objectionable feature lies. The method of classification of the leucocytes which is most generally accepted and used in clinical work is that of Ehrlich. All classifications developed by this method depend upon the treatment of the blood with a combined acid and basic stain, known as the Ehrlich three-color mixture. The most familiar to us are that of Ehrlich himself, and those of Thayer and of Cabot, which are derived directly from Ehrlich's. A review of them will serve to illustrate the faults of the method, to which I have referred.

Ehrlich divides the leucocytes of normal blood into five varieties, viz.: Lymphocytes, large mononuclear forms, transitional forms, polynuclear neutrophiles, and eosinophiles.

Thayer uses practically the same classification, but terms the neutrophiles *multinuclear* instead of *polynuclear*.

The latest development of this classification by the Ehrlich method is that of Cabot. He divides the leucocytes into five varieties: Small lymphocytes, large lymphocytes, polymorphonuclear neutrophiles, eosinophiles, and "mast cells." The first two forms include the first three of Ehrlich, the third and fourth the same in Ehrlich, and the fifth is a new class, including among the leucocytes of normal blood a kind of cell which Ehrlich considered abnormal.

These classifications depend upon at least three principles of differentiation: 1. The theory of the origin or development of the leucocyte. 2. The principle of relative size. 3. The principle of the selective color affinity of the leucocytes.

The same general criticism is true of the remaining classifications based upon this method, as Rieder's or Neusser's.

It also applies to those existing systems which utilize the principle of differentiation by staining reaction; but not the Ehrlich method of staining as that of Kanthack and Hardy.

The introduction of these several principles of differentiation tends to make the definitions of the separate varieties bulky, and difficult to fix in the mind.

The adoption of terms involving theories of development is, in the present state of our knowledge of the blood, of doubtful value, particularly for purposes of instruction. The

employment of the relative size of the corpuscles as a principle of differentiation is productive of much confusion in practical work.

Two years of instruction in the theory and practice of the clinical examination of the blood have convinced me of the need of a classification involving a simpler method of differentiation, and a more intelligible terminology. Following this idea, I have endeavored to reach a system dependent upon a single principle of differentiation, and possessing a terminology composed of fully descriptive terms, that is, terms describing what is actually seen in examination.

The principle which suggests itself as most fitted for use as a single basis of classification is that accepted to-day as the essential principle of all practical systems, the differential staining reaction of the leucocytes.

The words adopted as competent descriptive terms are those describing the color reaction of the leucocyte when subjected to a special standard method of staining.

The development of the classification, and of the method of staining used, is based upon the investigation of the staining reactions of the leucocytes under the treatment of the various stains: that is, acid, basic, and combined stains.

The results of this investigation which are of importance for our purpose may be stated as follows:

The protoplasm of all the leucocytes contains distinct acid-staining and basic-staining elements. In some leucocytes the affinity of the basic elements for their stain is strong, and that of the acid for their stain, weak and easily discharged by a basic counterstain; while in other leucocytes the acid stains are strong and the basic weak and less tenacious. If blood be treated by a proper mixture of an acid and a basic stain (a combined stain), the protoplasm of certain leucocytes takes exclusively a stain resulting from the combination of the acid and basic stains, the so-called neutral stain.* It is found, further, that if blood be treated by a proper combination of an acid and a basic stain, the protoplasm of one class of leucocytes will take the basic stain exclusively, of a

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* This so-called neutral stain is in reality a differential acid stain.

second the acid stain exclusively, and of a third the neutral combined stain exclusively; and, finally, that by the use of a proper staining method all the leucocytes of normal blood may be made to fall in one of these three classes.

Upon these facts, particularly the last two, the method which I present depends. Both the classification and the method of staining are simply a modification of the Ehrlich method of the study of the leucocytes for purposes of clinical work.

In the systems already reviewed, derived from the original Ehrlich classification and dependent upon the Ehrlich method of staining, — which I shall speak of collectively as the Ehrlich classifications, — the fact that certain of the leucocytes may be differentiated and classified by their selective color affinity when stained with a combined acid and basic stain is utilized as an essential principle in the separation of two of the five classes — the neutrophiles and eosinophiles.

The further fact, however, that all the leucocytes may be classified on this same principle of color affinity is not recognized, or, at least, not utilized.

In addition to the neutrophiles and eosinophiles defined by their color affinity, we have lymphocytes, large mononuclear and transitional cells, or small and large lymphocytes, classed on the basis of their morphology, size, and the theory of their origin.

In the new system these latter forms of leucocyte are grouped into a color group, on the same principle as the first two, the neutrophiles and eosinophiles.

The principle which Ehrlich applied to the differentiation of two groups of leucocytes is extended to the classification of all the leucocytes.

In seeking this result it was necessary to keep in mind the fact that such a classification, to be of practical use, must be along the same lines as the older, much-used systems; that its groups must have the same place, and their relations the same significance, in physiological and pathological work, as the several divisions of the Ehrlich classification, and that it must be possible to correlate the groups of the old and new methods.

The divisions of the leucocyte in the Ehrlich systems, which are of importance on account of the relative variation in the numbers of each in conditions of health and disease, are the eosinophiles, the neutrophiles, comprising the leucocytes not characterized by their staining reaction, the lymphocytes, large mononuclear, transitional forms, and " mast cells."

I have, therefore, endeavored to develop a classification in which each of these divisions is maintained, and in which the members of each can be distinguished by the selective color affinity of their protoplasm.

To accomplish this result it was necessary to obtain a method of staining under the action of which all the leucocytes of blood could be placed in one of three classes, each being distinguished by the special color affinity of its constituent leucocytes, and corresponding in its makeup to one of the three important divisions of the Ehrlich classifications.

The Ehrlich method of staining blood, colors *definitely* two important classes of leucocyte — the neutrophiles and eosinophiles or oxyphiles. In addition, however, it colors *indefinitely* basophilic or oxyphilic, *or leaves unstained the protoplasm of the third important class, comprising thirty per cent. of all the leucocytes.* Thus, the lymphocytes, large mononuclear and transitional forms of Ehrlich, may with his stain take a basic or even an acid stain in their protoplasm, or no stain at all, while the " mast cells " take no protoplasmic stain, or in some cases slight basic stain. So that, in a classification on a strict color reaction basis, some of these forms must be grouped with the granular basophiles and some with the granular oxyphiles, where they do not belong in the scheme of their physiological and pathological significance; still others must go unclassified as unstained.

The result we seek cannot, therefore, be obtained by the regular Ehrlich method of staining blood. The required result can, however, be reached by a simple modification of this method of staining.

This consists in the application of a larger proportion of

basic staining substance to the specimen of blood than is provided in the Ehrlich three-color mixture.

This extra amount of basic stain may be applied by adding it to the original staining mixture; that is, making up a mixture of Orange G., Acid Fuchsin, and Methyl Green, containing a larger amount of Methyl Green than is provided in the Ehrlich formula; or it may be applied separately to the specimen of blood, after this specimen has been stained by the regular Ehrlich mixture. The required end is most easily accomplished and obtained in greater perfection by the second method, where the basic stain is applied separately, after the application of the regular Ehrlich stain.

This superiority of the second method may be explained as follows:

The protoplasm of the basophilic leucocytes contains both basophilic and oxyphilic substances. The affinity of each substance for its stain varies in different leucocytes of the same class. So that with a mixture of acid and basic stains, in which the basic stain is not strong enough, some of the basophiles will take on an oxyphilic stain, and some no stain; as, for instance, with the ordinary Ehrlich stain. Enough basic stain must, therefore, be added to give all the basophiles their characteristic color reaction. If too much basic stain be added, however, the proportion of the acid and basic stains necessary to make the so-called neutral stain is destroyed, and thus the typical stain for the neutrophiles is not obtained.

It is difficult to grade this proper amount of basic stain to suit all conditions in a standard mixture, particularly as the relative intensity of the color affinity of the leucocytes varies in different bloods.

By applying the extra basic stain separately, however, the intensity of the basic staining can be graded perfectly to suit the particular specimen, by varying the time of application of this stain; and the neutrophilic tints when once set by the neutral stain seem to be little affected by the extra basic stain.

If blood be stained by this method it will be found that

all the leucocytes may be divided into three classes, on the basis of the selective color affinity of their protoplasm.

This modification of the Ehrlich method of staining blood gives an opportunity to classify the leucocytes in three varieties on the basis of a single principle of differentiation.

This same principle which serves as the basis of classification, the selective color affinity of the leucocytes, also provides an appropriate descriptive terminology for each of the varieties in the system. The leucocytes with the basophilic protoplasm we call Basophiles, those with the neutrophilic, Neutrophiles, those with the oxyphilic, Oxyphiles, the name in the case of each variety providing a description of the characteristic appearance of the particular leucocyte.

The detail of the preparation of blood specimens by this method is as follows:

The blood slide should be heated for from five to fifteen minutes at a temperature of 110° to 120° C. The specimen is then stained for from three to five minutes, with a three-color mixture prepared by the following formula:

Saturated watery solution of Orange G.	.	.	135 cc.
" " " " Acid Fuchsin .	.	140 cc.
" " " " Methyl Green .	.	125 cc.
Glycerine .	.	.	.	.	.	.	.	100 cc.
Absolute Alcohol	.	.	.	.	.	.	200 cc.
Distilled water .	.	.	.	.	.	.	300 cc.

The specimen is then dried and stained for from one to three seconds in a Löffler's solution of Methylene Blue.

It is then mounted and examined. The length of time for staining in the Löffler solution must be varied according to the particular specimen. In one, one second's exposure suffices to color all the basophiles, in another it may take three to five seconds. In staining pathological specimens of blood great care must be taken not to stain too deeply with the extra Methylene Blue, as the stroma of nucleated red corpuscles which may be present will take a slight bluish tint in a specimen overstained in the basic dye. This error does

not make difficult the distinction of these nucleated red forms from basophiles, as the basic stain in the protoplasm of the basophiles is laid down in threads or granules, while in a nucleated red corpuscle the color is absolutely diffuse. Nevertheless, it is best to avoid the possibility of the com-plication.

When properly stained the differentiation of these nucleated red corpuscles from basophiles is much less difficult with this than with the Ehrlich method.

This last fact gives the new method and classification an advantage over the old, for purposes of work on pathological blood.   A further advantage is found in the grouping of the lymphocytes, large mononuclear and transitional forms, and " mast cells " into one class.

The doing away of the differentiation of these forms has no disadvantage, since, as far as our evidence goes, their significance from a clinical standpoint is the same, while their grouping greatly simplifies the records in practical work.

I have given this exact formula for the three-color mixture stain, as in my experience the stains made up by it give the best results.   As a matter of fact, however, good results may be obtained with practically all the preparations of the Ehrlich mixture, known as the Biondi-Ehrlich or the Biondi-Ehrlich-Heidenhain three-color mixture, if the application of the Löffler solution is graded to suit the particular Ehrlich stain used.

The conclusion from the data which I have reported is as follows :

The leucocytes of normal blood may be classified in three varieties on the principle of the selective color affinity of their protoplasm, when treated with a standard method of staining.

These three varieties are : BASOPHILES; NEUTROPHILES; OXYPHILES.

The BASOPHILES are leucocytes, having an exclusive basic stain in their protoplasm.   The nucleus is round or irregular in shape.   In some forms it occupies most of the area of the cell ; in others, but half that area.   It stains blue.   The blue stain of the protoplasm is deposited in a fine reticular, thread-

like substance in some forms; in others, in fine or coarse granules; in some forms, in both rays. The size of the cell varies from 6 μ. to 25 μ. This class includes the large and small lymphocytes, the " mast cells," and transitional forms of the Ehrlich methods.

The NEUTROPHILES are leucocytes, having a neutral stain in their protoplasm. The nucleus is irregularly shaped and may appear as several nuclei. It stains with the basic stain. The staining substance of the protoplasm is deposited in fine irregularly shaped granules of lilac or purple color. The cell is usually of large size, but varies. This leucocyte corresponds to the polynuclear or the polymorphonuclear neutrophile of the Ehrlich methods.

The OXYPHILES are leucocytes, having an oxyphilic stain in the protoplasm. The staining substance of the protoplasm is deposited in granules of golden-red color. The cell varies in size. The nucleus is of irregular shape and stains blue. This leucocyte corresponds to the eosinophile of Ehrlich.

The differential proportion of the leucocytes of normal blood by this classification is as follows:

Basophiles   .   .   .   .   25 to 35 %
Neutrophiles   .   .   .   .   .   60 to 76 %
Oxyphiles   .   .   .   .   .   . $\frac{1}{2}$ to 4 %

GLYCOSURIA IN DIPHTHERIA.

C. M. HIBBARD AND M. J. MORRISSEY.

These observations were made on diphtheria cases in the South Department of the Boston City Hospital. A positive reaction for sugar noted on a few occasions, by Fehling's test, suggested the study. The tests were first made by Fehling's method. If there was a reduction of the copper a specimen of the urine was then tested by the phenylhydrazin method.

Fehling's test was made about 1,000 times on 230 patients. There were 65, or about 25 %, positive reactions. It was found in 17 of 22 fatal cases, or 77 % ; and in 39 of 208

recoveries, or 19%. The percentage of positive reductions in regard to the location of the diphtheritic membrane was:

No membrane 0%
Membrane on tonsils 9%
Membrane in nose 40%
Membrane in larynx 31%
Membrane on tonsils and in nose 33%
Membrane on tonsils and larynx 58%
Membrane in nose and larynx 67%
Membrane on tonsils, nose, and larynx   .   .   .   80%

In a second series of 96 cases the examinations were made frequently from the beginning of the illness and continued for at least two weeks, by both Fehling's and the phenylhydrazin tests. When the results were positive with both methods glycosuria was considered present; the percentage is seen below:

No membrane 0%
Membrane on tonsils 18%
Membrane in nose 50%
Membrane in larynx 60%
Membrane on tonsils and in nose 44%
Membrane on tonsils and larynx 60%
Membrane in nose and on larynx 100%
Membrane on tonsils, nose, and larynx .   .   .   66%

Glycosuria was found in 8 of the 9 that died, and in 25 of the 87 that recovered, and in 34% of all cases. Glucose was observed more frequently in cases that had extensive diphtheritic processes.

The time that Fehling's test was first positive varied from the second to the eighteenth day of illness.

The duration varied from one day to several weeks.

Seven cases left the hospital with a slight glycosuria. In the 86 positive reactions with Fehling's solution, 16 were immediate, 3 were quantitated and had $1\frac{1}{2}$ and 2 and $3\frac{1}{3}$% of glucose respectively. Out of the 16 cases with an immedi-

ate reduction, 8, or 50%, died.   Thus an immediate reaction by Fehling's reagent would appear to be of serious prognostic significance.

The frequency of the presence of glycosuria and albuminuria in the same patient is shown in the table below:

No albumin .   .   .   .   No sugar.
When a slight trace of albumin   .   .   10% had sugar.
When a large trace of albumin   .   .   31% had sugar.
When $\frac{1}{8}$ of 1% or more albumin   .   .   80% had sugar.

The occurrence of a positive reaction by Fehling's test in scarlet fever was studied by Mr. C. H. Dean.

In ninety-three cases of scarlet fever there were fifteen positive reductions.   Four patients had such a suspicious-looking membrane that they were given antitoxin; three of these had a yellow reaction.   In 36 cases of scarlet fever with positive cultures of diphtheria bacilli in the nose or throat, 11, or about 30%, had a positive reaction.   Of 17 of these last cases that had antitoxin, 6, or 35%, had a positive reaction.   With three exceptions these reactions occurred only once.

In one hundred and seven cases of scarlet fever that did not receive antitoxin, 17, or 16%, had a positive reaction by Fehling's test, and in 21 that did have antitoxin, 9, or 43%, had a yellow reduction.

The question arose then, Was the antitoxin treatment, which most cases of diphtheria received, responsible for the glycosuria in our patients?   To answer this, the urine of twenty cases of diphtheria was examined before any antitoxin was given, with the following result:

Fehling's test:

     15 cases negative.

     1 case had a slight reduction in 24 hours.

     3 cases had a good reduction in 24 hours.

     1 case had an immediate reaction.

Phenylhydrazin test:

     10 cases had no crystals.

6 cases had a few osazon crystals.

4 cases had many osazon crystals.

Thus it was shown that antitoxin cannot be considered as the full explanation of the presence of glycosuria in our cases of diphtheria.

To learn if antitoxin injected into a patient would produce a glycosuria, 10 cases that did not have sugar were given antitoxin. Fehling's test was twice positive, and the phenylhydrazin four times. Hence, it seemed that antitoxin produces at times a glycosuria; usually it is so slight that it is shown only by the most delicate test, but occasionally in sufficient quantity (0.05 %, at least) to reduce Fehling's solution. This glycosuria continues only for a few days.

During the time these observations were made 9 cases of measles and 68 of tonsillitis were tested by Fehling's reagent, with only one positive result in tonsillitis, which, unfortunately, was not confirmed by the phenylhydrazin test.

A CASE OF TRUE ALBUMOSURIA.

EDWARD S. WOOD.

The specimen was shown and the reactions for albumose in the urine were demonstrated.

Concentrated HNO_3 added to the urine, as in the ordinary nitric acid test for albumin, gives a zone of coagulum corresponding to more than $\frac{1}{4}\%$ of albumin. This test does not serve to distinguish between serum albumin and albumose.

Ten or fifteen cubic centimetres of the urine in a test tube treated with a few drops of dilute nitric acid, or with one drop of acetic acid, and warmed gently, gives a bulky precipitate which disappears on continuing the heat to the boiling-point. On cooling, the precipitate reappears.

Treated with acetic acid and a few drops of a ferrocyanide of potassium solution as in testing for albumin, the precipitate which appears, especially after warming gently, disappears on boiling and reappears on cooling.

The urine, rendered alkaline with NaOH and treated with a few drops of very dilute $CuSO_4$ solution, yields a beautiful

violet color in the cold (biuret reaction). This serves to distinguish the albumose from every other proteid except peptone, which yields no precipitate with concentrated HNO_3, or any of the above tests.

The presence of albumose in the urine is liable to be overlooked, if only the nitric acid test for albumin be employed.

Urinary albumose corresponds more closely in its reactions to heteroalbumose than to any of the other varieties, but the recent investigations of Matthes seem to show that it is a nucleoalbumose.   .

CYSTIN CALCULUS.

EDWARD S. WOOD.

A cystin calculus was shown which was recently removed by Dr. J. C. Warren from a female bladder by suprapubic operation.

This calculus is probably the largest pure cystin calculus in existence.   It weighed after drying ℥ 3, gr. 129 = 1,569 grains = 101,883 grm. (See p. 83.)

It is homogeneous in its structure, has a more or less crystalline surface, is a flattened oval 2⅝ × 2⅜ × 1⅜ inches, and on section is seen to have a crystalline structure, radiating from the centre to the periphery, and not made up of concentric layers.

ON THE UTILIZATION OF THE NORMAL TONSILLAR ABSORP- TION IN THE TREATMENT OF TUBERCULOSIS OF THE ANGULAR LYMPHATIC GLANDS.

J. L. GOODALE.

In May, 1897, the writer reported before this Society a series of experiments in the human subject,[1] which demonstrated the existence of tonsillar absorption.   The conclusions furthermore afforded by the investigations were as follows:

I.   Tonsillar absorption takes place through the mucous membrane of the crypts.

II.   The path of the absorbed substances is in the inter-

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[1] See, also, Archiv für Laryngologie, Band VII, Heft 1.

CYSTIN CALCULUS DESCRIBED IN TEXT. ACTUAL SIZE.

1. — Interior Surface. 2. — Exterior Surface.

follicular lymph channels in the direction of the larger fibrous trabeculæ at the base of the organ.

III.   During the process of absorption, foreign substances encounter phagocytic action on the part of the polynuclear leucocytes situated in and adjoining the mucous membrane.

IV.   Bacteria are normally present in the crypts, but are not usually demonstrable in the tonsillar tissue proper.

V.   In view of the preceding facts, the supposition appears possible that bacteria may be continually making their way into the tonsillar tissues, but, at the moment of entering, encounter conditions which terminate their existence.

The application of these facts to the subject of tubercular infection of the tonsils, and of the angular lymph glands, leads us to conclude that a bacterial invasion from the mouth is possible.   Examinations of human tonsils have shown bacilli of tuberculosis to be present with comparative frequency on the free epithelial surface or in the crypts.   If the bacilli once pass the phagocytic barrier in and around the mucous membrane of the crypts, it appears reasonable to suppose that they will be carried into the interior of the tonsil, and either be there deposited or transported by the lymph stream to the angular lymph glands.

On the basis of the foregoing considerations, the writer suggests that it should be possible to make use of the normal tonsillar absorption in the treatment of tubercular angular glands.   It seems reasonable to suppose that medicinal substances introduced into the crypts of the tonsils would make their way into the angular glands along the path followed by the bacilli.   If we possessed any substances capable of affecting tubercular glands, the introduction of such substances into the tonsillar crypts should be followed by an effect upon the angular glands.

Experimental confirmation of this supposition has been obtained by the writer in numerous instances.   While detailed presentation of the results will be left for future publication, it may be here stated that the introduction of iodine solutions into the tonsillar crypts in cases of tubercular angular lym-

phadenitis has been followed by a marked diminution in the size of the swollen glands.

The object of the present paper is simply to demonstrate that we possess in the utilization of tonsillar absorption a method of applying medicinal substances directly or almost directly to the angular lymph glands. A desirable opportunity seems thus to be afforded for employing and testing remedies thought to be of value in the treatment of tubercular processes.

[Abstract of a paper read before the Boston Society for Medical Improvement, Jan. 24, 1898.]

SPECIAL NOTICE.

The Journal will be published *immediately* after the meetings of the Society, and will contain authors' abstracts of the papers presented, when these papers are not given in full.

By general consent of the Heads of Departments it will contain full abstracts of experimental work carried on in the following institutions: the Medical School of Harvard University, the Experiment Laboratories of the Massachusetts General and the Boston City Hospitals, the Physiological and Biological Departments of the Massachusetts Institute of Technology, Clark University, and the Anatomical Laboratory of Brown University.

Papers and abstracts of papers upon subjects connected with the Medical Sciences will be welcomed from persons not members of the Society, and if approved by the Council will be presented at the meetings, and will be given a place in the Journal.

When desired, the insertion of papers, if in abstract, will be accompanied by a note indicating the place where they may be found in full. Fifty reprints will be furnished free to authors if the desire for them be expressed on the manuscript.

Subscribers to the Journal are invited to attend the meetings of the Society; the next will be held on March 1 and 15, at the Harvard Medical School, at 8 P.M.

All communications should be addressed to the Editor,

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Harvard Medical School,
688 Boylston Street,
Boston, Massachusetts, U.S.A.

JOURNAL

OF THE

Boston Society of Medical Sciences

CONTENTS.

At the meeting of March 1, 1898, the following communications were made:

ANTITOXIN IN THE TREATMENT OF DIPHTHERIA.

JOHN H. McCOLLOM.

Antitoxin has been in general use for about four years, and the results now obtained are as gratifying as those occurring during the earlier days of its administration. The percentage of mortality from diphtheria in Boston from 1880 to 1894 was 30.75, while that from 1895 to 1897 was 12.61. The ratio of mortality from diphtheria per 10,000 of the living in this city is quite large, but during the last three years it has gradually diminished. An examination of this ratio for ten years, from 1888 to 1897, shows that in 1888 the ratio was 13.88 per 10,000; that in 1889 it was 15.65; that in 1890 it was 10.30; that in 1891 it was 6.23; that the rate for 1892 was 10.29; that for 1893 it was 11.45; that in 1894 it was 18.03; that in 1895 it was 11.73; in 1896 it was 9.80; and in 1897 it was 7.7. If we go back to the semi-decade from 1861 to 1865 the ratio is found to be 11.10, while in the semi-decades from 1866 to 1870, and from 1871 to 1875, the ratio is 6.54 and 7.20. This apparent diminution in the mortality ratio can be explained by the fact that diphtheria was not so carefully investigated, and that the diagnosis was

not based upon a bacteriological examination, and therefore
many cases which were diphtheria were not recognized as
such. For instance, in Boston in 1872, with a population of
265,764, there were only 94 deaths from this disease. It is
not reasonable to suppose, from what is known of the preva-
lence of diphtheria at the present time, that during 1872 there
could have been only 94 deaths from so fatal a disease as
diphtheria. It has been claimed by the opponents of anti-
toxin that the mortality statistics of this disease are fallacious,
because by a bacteriological examination many mild cases
are recognized as diphtheria which formerly would have been
classified as tonsillitis and other inflammatory processes in
the throat. While this may be true to a certain extent, yet
this so-called source of error cannot be considered an impor-
tant factor in invalidating the accuracy of the statement that
the ratio of mortality from diphtheria to the living has
materially diminished since the introduction of antitoxin.
From 1894 to 1897 the ratio of mortality has diminished
more than one-half; in 1894 the ratio was 18.03; in 1897 it
was 7.7. The most important argument, however, in favor
of antitoxin, is the diminution in the percentage of mortality
in hospital cases. It has also been claimed that these state-
ments were unreliable because based on mild attacks of the
disease; but this cannot be considered correct, because mild
cases of disease are not sent to hospitals, as a rule. The
hospital death rate from diphtheria before the introduction
of antitoxin, not only in this country but also in Europe,
was about 46 per cent. In the South Department of the
Boston City Hospital since it was opened, Sept. 1, 1895, to
the 1st of February, 1898, there have been 3,861 cases of
diphtheria treated, with a percentage of 14.3. Lest it might
be said that diphtheria might have assumed a milder type
during these two years and five months, it may be of interest
to note that in the first five months the percentage was 13;
that in the year ending Feb. 1, 1897, it was 15.3; and in the
year ending Feb. 1, 1898, it was 13.5; not a very great
variation. If the moribund cases, or the cases that died
within 24 hours of admission, are eliminated, the death rate

of cases amenable to treatment would be about 11 per cent. *It must be borne in mind that these cases were diphtheria both from a bacteriological and from a clinical point of view.*

For the purpose of investigating the fatality at different ages, and the relative frequency of the disease in males and females, 800 cases were collected. It was found that of the 800 cases, 669, or about 83 per cent. of the whole number, occurred in children 15 years of age and under; while in persons over 15 there were only 131 cases, or about 16 per cent. The highest death rate was in infants under 1 year, being 45 per cent.; the next highest in children between 1 and 2 years, being 39 per cent. The number of cases occurring in children between 2 and 3 years of age was the largest in any one year of life under 15 years, being 81, and the death rate was 35 per cent. Over 4 years of age the death rate shows a remarkable diminution each year of life up to 15. After 15 years the death rate has been estimated at intervals of 10 years, and it has been found that during these epochs of life there were 131 cases, as has been before stated, with a death rate of 16 per cent. The death rate in persons 40 years old is quite high, being 29 per cent., — higher than that of any age of three years and over. It is a notable fact that in children from 10 to 15 years of age there were 79 cases and only 2 deaths. Regarding the relative frequency of diphtheria ·in males and females, it was found that, while the susceptibility to the disease is greater in females than in males, the death rate in the former is considerably lower than in the latter. There seems to be no satisfactory explanation of this fact. In the earlier years of life sex certainly can have no influence on the susceptibility to disease, neither can it have any effect on the resisting power of the individual. In the first five years of life the difference between the death rate of the sexes is very marked, being 30.2 per cent. in males, and 20.4 per cent. in females. From 5 to 10 years the death rate in males is 10.8 per cent., and that of females is 7; from 10 to 15 years the rate for males is 3.33, whereas of females of a corresponding age, 49 cases, the death rate is 0. Over 15 years of age the death rate

for males is 8 per cent., while that of females is 4 per cent.;
a marked difference.   The death rate in these 800 cases was
15.1 per cent.   In an analysis of the fatal cases it was found
that the pulse rate was extremely high, the highest being
180, the lowest 100, with an average of 142.   A low pulse
rate is frequently found in the course of the disease in a fatal
case, but this symptom was observed in only a few instances
in this series.

In all of the operative cases, except one, intubation was
done.   In two of these intubation did not relieve the stenosis,
and therefore tracheotomy was done.   In one the initial oper-
ation was tracheotomy.   Intubation in every case, except
in the two just mentioned, relieved the laryngeal stenosis, but
the patients died from broncho-pneumonia, or from extension
of membrane into the smaller bronchi, or from sepsis, and
in a few instances from cardiac failure.   In no instance could
death be attributed to a failure to relieve the laryngeal
stenosis or to the operation.   In the three cases in which tra-
cheotomy was done, death was due to extension of mem-
brane in two, and broncho-pneumonia in one.   Where there
was an autopsy, in no instances, in the intubation cases, was
there the slightest indication that tracheotomy would have
been the better operation; in fact, in many the condition of
the patient was such that if the latter operation had been
performed death would have occurred on the table.   A care-
ful consideration of the course, the manner of death, and the
result of the autopsies justifies the conclusion that in chil-
dren, in the vast majority of cases, intubation is the better
operation.   In adults tracheotomy is to be preferred.

Thirty-seven cases of intubation and one tracheotomy
case recovered.   In many of the intubations the tube was
inserted several times.

From the nature of the disease in which tracheotomy is
generally performed, the wound is specially liable to infection.

Drs. R. W. Lovett and John C. Munro state, in a paper
entitled " A Consideration of the Results in 327 Cases of
Tracheotomy," performed at the Boston City Hospital from
1864 to 1887, that 232 died and 95 recovered, giving a per-

centage of recoveries of 29.05.   In the same paper is a table
compiled by them from German, British, French, and Amer-
ican authors, embracing 21,853 cases, with a percentage of
recoveries of 28.   In the 79 intubation cases, which form a
part of these 800 cases of diphtheria, the percentage of recov-
eries is 46.8.   In a previous report of 200 cases of intuba-
tion, by the writer, 93 recovered and 107 died.   If these 279
cases of intubation, with a percentage of recoveries of 46.5,
are compared with the 327 cases of tracheotomy, to which
allusion has just been made, it will be seen that in the former
the percentage of recoveries was 46.5, while that of the latter
was only 29.05.   In an analysis of the cause of death, in the
327 cases of tracheotomy, it was found that of the 232 deaths,
sepsis was responsible for 62, or 26.7 per cent.; while of the
279 intubations, sepsis caused death in only 20 instances,
giving a percentage of 13.4 as compared with 26.7 in the
tracheotomy cases.

Alcoholic and cardiac stimulants have been very freely
administered with marked benefit.   Applications to the throat,
as a rule, have not been made.   Saline irrigation of the throat,
while not affecting the course of the disease, has contributed
largely to the comfort of the patients.   Irrigation with a weak
solution of corrosive sublimate has been used somewhat fre-
quently, but it did not seem to be of any special advantage
in comparison with the saline irrigation.

From the study of these 800 cases of diphtheria, the
following conclusions are justifiable:

First.   That the pulse rate in diphtheria is uniformly
accelerated.

Second.   That the temperature in this disease is not
specially elevated.

Third.   That in the laryngeal cases, intubation is the
operation of election.

Fourth.   That albuminuria is quite a constant symptom in
diphtheria.

Fifth.   That the use of antitoxin has very materially
reduced the death rate of diphtheria.

PRACTICAL USE OF THE GASTRODIAPHANE.

HENRY F. HEWES.

The method of inspection of the stomach by gastro-diaphany was brought before the Society. The demonstration showed the facility with which the inspection of the size and position of the stomach may be accomplished in a subject with a thin abdominal wall.

THE GENERAL INFECTIONS AND COMPLICATIONS OF DIPHTHERIA AND SCARLET FEVER.

A Bacteriological Study of One Hundred and Fifty-seven Cases.[1]

RICHARD MILLS PEARCE.

(*First Assistant in Pathology, Boston City Hospital.*)

This paper is a report of the bacteriological examinations of 157 cases of diphtheria and scarlet fever, which have been examined post-mortem at the South Department of the Boston City Hospital between February 1 and December 7, 1897. This does not include all the cases which have come to post-mortem examination, but only those of diphtheria in which an absolute diagnosis has been made both clinically and bacteriologically, and only those of scarlet fever in which the clinical diagnosis was perfectly clear.

A report of the macroscopical and microscopical appearances is now being prepared by Drs. W. T. Councilman and F. B. Mallory. A study of these cases has been made with two objects in view: first, to determine the frequency and nature of the general infection, particularly that with the Klebs-Lœffler bacillus; secondly, to determine the bacterial nature of the complications, particularly broncho-pneumonia and affections of the middle ear. For a study of this nature a large number of cases, such as we have here, is of greater value in forming conclusions than a small number of picked cases. These cases have been taken in order, without dropping unimportant ones. In this way I hope to be able to show the bacteriological side of the average run of cases of

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[1] Boston City Hospital Medical and Surgical Reports, 1898.

diphtheria and scarlet fever in hospital wards.   The diagnosis of the various bacteria has been based on morphological and cultural characteristics, and in cases where the organisms have occurred in unusual locations, on examination of stained sections.   Lœffler's blood-serum has been used as the routine culture medium, with other special media when necessary for purposes of differentiation.   For studying the organisms in tissues, Unna's Alkaline Methylene Blue, preceded by aqueous Eosin, as a contrast stain, has been used.

The work has been done at the suggestion and under the direction of Prof. W. T. Councilman, in the Pathological Laboratory of the Boston City Hospital.

There have been examined in all 157 cases, which have been divided, according to the clinical diagnosis, into three groups.

I.   Diphtheria, 94 cases.

II.   Diphtheria complicated by other infectious diseases, 46 cases (with scarlet fever in 29, with measles in 11, and with scarlet fever and measles in 5).

III.   Scarlet fever, 17 cases (in 3 of which measles was also present).

These will be spoken of as groups I., II., and III., respectively; and they will be taken up in the order mentioned, the general infection being considered first, and then the complications.   ·Groups I. and II., on account of the frequency with which the Klebs-Lœffler bacillus occurs in both, will be considered together, although the results of the examination in each group will be stated separately.

General Infections in Groups I. and II.

Frosch (1) was the first observer to note in a series of cases the occurrence of the Klebs-Lœffler bacillus in the internal organs (heart's blood, liver, spleen, kidney, and lymph glands).   In 1895 he reported that he had found it in 10 out of 15 cases examined.   Kolisko and Paltauf (2) had previously, however, noted its occurrence in the spleen in one case, as had also Schmor (3) in the cervical lymph glands in 7 out of 10 cases.   Booker (4) in one case found it in the

spleen, lung, submaxillary gland, and heart's blood. Kutscher
(5) found it in one case in the liver and kidney, and in the
lung in 8 out of 9 cases. Canon (6) found it repeatedly in
his post-mortem examinations. Kanthack and Stephens (7)
found it in the lung in each of 26 cases, in the spleen in 10
of 21 cases, in the kidney in 2 of 3 cases. Wright (8) in
14 cases demonstrated it in the lung 13 times, in the liver 3
times, in the spleen twice, in the cervical and bronchial
glands 5 times, in the mesenteric glands twice, in the heart's
blood once, and in the kidney once. In 7 of these cases
there was also a general streptococcus infection. Wright
and Stokes (9) in a later series of cases, which probably
included Wright's first series, reported 31 cases in which
the Klebs-Lœffler bacillus was found in the lungs 30 times,
in the liver 9 times, in the mesenteric glands 7 times, in the
spleen and heart's blood, each, 5 times, in the cervical glands
4 times, in the brain and bronchial glands, each, twice. The
streptococcus was present in 20 cases, and the pneumococcus
or staphylococcus pyogenes aureus in 5 cases. Stokes (10)
in 9 cases, treated by antitoxin, found it in the lungs 9 times,
in the kidney 4 times, in the heart's blood and spleen, each,
once. Within the last year and a half Nowack (11) reports
22 fatal cases, in 21 of which the streptococcus was found in
the internal organs. In 9 of these cases it was associated
with the Klebs-Lœffler bacillus, and in one with a bacillus
resembling it except in virulence. Genersisch (12) in the
examination of 25 cases of " septic " diphtheria did not
always find the streptococcus present in the blood or internal
organs, and thinks the Klebs-Lœffler bacillus alone can pro-
duce the so-called " septic " symptoms. Reiche (13) in
examining 42 fatal cases found streptococci and staphylo-
cocci in 64.3%, streptococci alone in 45.2%, and the Klebs-
Lœffler bacillus alone, twice. Stephens and Parfitt (14)
report 3 fatal cases, one with a general infection with the
Klebs-Lœffler bacillus and the streptococcus, a second with
the Klebs-Lœffler bacillus only, and a third with the pneu-
mococcus. In the second case the bacilli were demonstrated
in cultures from the blood during life.

Flexner (15) has demonstrated a general infection with the bacillus of diphtheria in one case. Babes (46) has done the same. Dahmer (47) reports finding the strepto-coccus in the blood of diphtheria in about 50 per cent. of the cases which he examined. Of 36 cases he found it in the heart's blood and spleen in 17, and in the lung (with or without broncho-pneumonia) in 30. In 10 of the latter it was associated with staphylococci. He kept no record of the occurrence of the Klebs-Lœffler bacillus.

In inoculation experiments with guinea-pigs Wright (9) found the Klebs-Lœffler bacillus 19 times in 155 livers, 15 times in 152 spleens, 4 times in 151 kidneys, 7 times in the blood of 153 hearts. Abbot and Ghriskey (16) found that by inoculating testes of rabbits with Klebs-Lœffler bacilli, small bodies made up of leucocytes and Klebs-Lœffler bacilli were found in the omentum. Zarniko (17) in a few cases found Klebs-Lœffler bacilli in the necrotic foci of the liver of inoculated animals.

Of the 94 cases of group I., the *heart's blood* in 4 showed the presence of the Klebs-Lœffler bacillus, twice alone and twice with the streptococcus. In 9 cases the streptococcus occurred alone. In 1 case the pneumococcus occurred alone.

In the *liver*, the Klebs-Lœffler bacillus occurred in 24 cases, alone in 12 cases, and with the streptococcus in 12 cases. The streptococcus occurred in 27 cases, alone in 14, with the Klebs-Lœffler bacillus in 12, and with the staphylo-coccus pyogenes aureus in 1 case. The staphylococcus pyogenes aureus occurred in 4 cases, alone in 3 cases, and associated with the streptococcus in 1 case. The pneumo-coccus occurred alone once.

In the *spleen*, the Klebs-Lœffler bacillus occurred 18 times, in 15 of which it was the only microorganism present, and in 3 associated with the streptococcus. The streptococcus occurred in 24 cases, alone in 21, associated with the Klebs-Lœffler bacillus twice, and with the staphylococcus pyogenes aureus once. The staphylococcus pyogenes aureus occurred twice, once alone and once with the streptococcus. The pneumococcus occurred alone twice.

In the *kidney*, the Klebs-Lœffler bacillus occurred in 23 cases, in 15 of which it was alone, in 5 associated with the streptococcus, and in 2 with the staphylococcus pyogenes aureus. The streptococcus occurred in 26 cases, in 19 of which it was the only organism present. The staphylococcus pyogenes aureus occurred in 8 cases, in four of which it was in pure culture. The pneumococcus occurred 4 times, 3 times in pure culture and once with the Klebs-Lœffler bacillus.

In group II. (46 cases), the *heart's blood* showed the presence of the streptococcus in pure culture 9 times, and associated with the Klebs-Lœffler bacillus once. The Klebs-Lœffler bacillus occurred alone once.

The *liver* in 25 cases showed the presence of bacteria. The streptococcus occurred alone 10 times, with the Klebs-Lœffler bacillus 7 times, and with the staphylococcus pyogenes aureus 3 times. The Klebs-Lœffler bacillus occurred in pure culture 5 times.

The *spleen* showed the presence of bacteria in 20 cases. The streptococcus occurred alone 13 times and with the Klebs-Lœffler bacillus twice. The latter was present in pure culture 5 times.

The *kidney*, in 29 cases in which bacteria were found, showed the presence of the streptococcus, in pure culture, 10 times, associated with the Klebs-Lœffler bacillus 5 times, and with the staphylococcus pyogenes aureus 3 times. The Klebs-Lœffler bacillus occurred alone 7 times. The staphylococcus pyogenes aureus and the pneumococcus each occurred alone once, and together once.

It is of interest that, in both these series, the kidney had the greater number and variety of organisms.

References to the general infection in cases like those of the second group are not numerous. Wright reports 11 cases in which there was a general infection with the streptococcus in 4, and with the pneumococcus in 1.

In taking cultures from these organs, the amount of material used to inoculate the culture tubes was that which would adhere to the sides of a sterilized, flattened platinum

wire thrust into their substance; the surface being first seared with a heated spatula. In the case of the heart's blood, the needle was thrust into the latter portion of the blood as it escaped from the right auricle after cutting into the inferior vena cava. Thus it will be seen that a comparatively small amount of material was used for inoculation. In most cases, nevertheless, the growth of the Klebs-Lœffler bacillus was fairly abundant, generally from 3 to 15 colonies on each tube; but sometimes many more. Thus, several times it was noted that cultures from certain livers showed 18, 24, 25, and 35 colonies respectively. The spleen cultures never showed more than 9 colonies. The kidney cultures in 2 cases showed 19 and 24 colonies respectively. In some cases the growth was only in the water of condensation. This was especially true of the heart's blood, in which in only 2 of the 6 cases were there distinct colonies (3) on the surface of the serum; the other 4 having a growth only in the water of condensation. The results (as regards the amount of the growth) differ from those of most of the observers mentioned above (excepting Kanthack and Stephens, and Flexner), in that they considered it necessary to use a large amount of material in order to demonstrate the presence of the bacillus at all. In some of the cultures from these organs involution or degenerate forms were present in considerable numbers.

The clinical significance of this general infection with the Klebs-Lœffler bacillus is not apparent. It occurred generally, but not always, in the gravest cases, or those known as "septic" cases. It is probable that it may be due to a diminished resistance of the tissue cells, or of the germicidal power of the blood. In this series of fatal cases, the number of infections with the streptococcus, and with the Klebs-Lœffler bacillus, were about even, though slightly in favor of the streptococcus.

Whether the Klebs-Lœffler does or does not continue to produce its toxic products wherever it may be, in the blood or internal organs, it is impossible to say; but from the number of fatal cases with such an infection, it would seem very

probable that it does.   Kanthack and Stephens (7) incline
to this opinion; and as previously stated Genersisch (12)
considers many of the so-called "septic" cases to be due to
such an infection, independently of the streptococcus.

  In comparing groups I. and II., the general infection
appears to be about equal: thus group II. with 46 cases has
about the same percentage of cases with general infection as
group I. with 94 cases.   This is true as regards infections
with both the streptococcus and the Klebs-Lœffler bacillus,
but, as would be expected, the former is more numerous than
the latter.

Complications in Groups I. and II.

Broncho-pneumonia. — The presence of the bacillus of
diphtheria in this complication was first noted by Thaon
(18) in 1885, later by Johnson (19) and Martin (46), each
in 1 case.   By Strelitz in 1 out of 8, by Flexner (15) in 1
out of 2, by Mosny (21) in 1 out of 3, by Kutscher (5) in 8
out of 9, by Netter (22) in 4 out of 7 cases, and by
Frosch (1).   Wright and Stokes (9) found it in 18 out of
19 cases, in 8 of which it was obtained in pure culture and
in the other 5 was associated with the streptococcus.   Kan-
thack and Stephens (7) also found it in most of their cases.
Belfonte (52) reports 26 cases in which he found the Klebs-
Lœffler bacillus 21 times.   In 4 cases it occurred in pure
culture.   He found the streptococcus in 20 cases, alone once;
the staphylococcus pyogenes aureus in 10 cases, alone once;
and the pneumococcus in 3 cases.   He concludes that the
Klebs-Lœffler bacillus either alone or associated with other
organisms may cause broncho-pneumonia.

  Of other organisms associated with this complication,
the pyogenic cocci are the most common, particularly the
streptococcus.   According to Thaon (18), A. Fränkel (23),
Prudden (24), Newmann (25), Mosny (21), Northrup (24),
and Wright (8, 9), the pneumococcus has also been found to
be often present.   Wollstein (45) reports 33 cases occurring
in the Babies' Hospital, New York, 14 of which were second-
ary to diphtheria, scarlet fever, or measles.   In 11 of the

latter the pneumococcus was found. In 2 cases it occurred in pure culture, and in the others was associated with the streptococcus and staphylococci.

In the first group of cases broncho-pneumonia was present in 60. The Klebs-Lœffler bacillus occurred in 46 and the streptococcus in 33 cases. The Klebs-Lœffler bacillus occurred alone in 10 cases, and associated with the streptococcus in 11, with the streptococcus and staphylococcus pyogenes aureus in 7 cases, with the latter only in 3 cases, and with the pneumococcus in 4 cases. The streptococcus occurred alone in 8 cases, with the staphylococcus pyogenes aureus in 3, and with the pneumococcus in 2. The pneumococcus occurred in 8 cases, in 2 of which it was in pure culture. The staphylococcus pyogenes aureus occurred in 11 cases, but always in connection with other organisms. (Of the 58 cases reported above 15 were included in a previous bacteriological report of 128 cases of broncho-pneumonia.) The presence of the Klebs-Lœffler bacillus in such a large number of cases cannot be due entirely, as is claimed by some observers, to the penetration of small bronchi by the needle while taking cultures, for stained preparations of the lungs in these cases show the bacilli to be present in the exudate in the alveoli in nearly all cases, and often in immense numbers.

The observation that in some cases, both in culture and in histological preparation, the Klebs-Lœffler bacilli are present in much larger numbers than are the pyogenic cocci, and that in 17% of the cases they occurred in pure culture, would indicate an etiological relation. In a previous report [1] on this condition it was present in 62 out of 73 cases, in 17 of which it was in pure culture. Kanthack (7) and Kutscher (5) both think that a broncho-pneumonia may be due to the Klebs-Lœffler bacillus without the aid of the pyogenic cocci.

In group II. broncho-pneumonia occurred in 24 cases. The Klebs-Lœffler bacillus occurred in 19 cases. In only one case was it found in pure culture. In the others it was associated with either the streptococcus or the staphy-

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[1] The bacteriology of Lobar and Lobular Pneumonia. Bost. Med. and Surg. Jour., Dec. 2, 1897.

lococcus pyogenes aureus, or both. The streptococcus occurred in 13 cases, in 2 of which it was the only organism present.

The pneumococcus occurred alone once, and with the bacillus pyocyaneus once. The staphylococcus pyogenes aureus occurred in 11 cases, but always in combination. The albus occurred alone once.

The results of this group differ from those of group I. only in the increased frequency of the presence of the pyogenic cocci; particularly the streptococcus. The observation of most investigators, that broncho-pneumonia in the majority of cases is due to a combination of organisms, most frequently the pyogenic cocci, is supported by the results in both groups.

Empyema was found in the first group in 2 cases and a fibrinous pleurisy in 1 case. The streptococcus was found in both cases of empyema, in 1 in pure culture, in the other associated with the Klebs-Lœffler bacillus. The cause of the empyema in this second case was the rupture of a small abscess near the surface of the lung. This lung showed broncho-pneumonia with multiple small abscesses from which in cultures the Klebs-Lœffler bacillus and the streptococcus were found. The fibrinous pleuritis was due to the pneumococci.

In the second group there were 2 cases of empyema and 2 of fibrinous pleuritis. In the first 2 cases the streptococcus was present in both, in 1 in pure culture, in the other associated with the Klebs-Lœffler bacillus. In this last case, which had been operated upon, there were the remains of a small abscess cavity on the surface of the lung. The 2 cases of fibrinous exudate showed pneumococcus in one, and the pneumococcus and the streptococcus in the other.

The only reference that I can find in regard to the occurrence of the Klebs-Lœffler bacillus in the above condition is that of Frosh (1). He found it not only in the pleural, but also in the pericardial exudate. The organisms most commonly found are the streptococcus, pneumococcus, and, less often, the staphylococcus pyogenes aureus.

Abscess of the lung occurred in 3 cases of the first group.

In I the Klebs-Lœffler bacillus and streptococcus were found, in a second the Klebs-Lœffler bacillus and the staphylococcus pyogenes aureus, and in a third the streptococcus with the staphylococcus pyogenes aureus and albus. This first case corresponds to the second case of empyema in group I.

In the second group, abscess of the lung occurred in 2 cases. In one the streptococcus was found and in the other the streptococcus and Klebs-Lœffler bacillus. This last case corresponds to the second case of empyema in group II.

Acute pericarditis occurred not at all in the first and 3 times in the second group. In 2 of the latter the pneumococcus was found and in I the streptococcus.

Acute ulcerative endocarditis. — But 2 cases of endocarditis in which the Klebs-Lœffler bacillus has been found in the vegetations are on record. The first was that of Howard (26), who cultivated from the valvular vegetations in the heart, and from infarcts in the spleen and kidney, a bacillus identical with the Klebs-Lœffler bacillus in everything except virulence. Wright (8) reports a case in which the aortic and tricuspid valves were affected, and in which cultures showed the pneumococcus, staphylocci, and a bacillus corresponding to the Klebs-Lœffler bacillus, except that it was non-pathogenic for guinea pigs.

In the first group there was one case of endocarditis from which the streptococcus was obtained in pure culture. In this there existed a general streptococcus infection.

In one case of the second group, on the mitral curtain, was a reddish-gray, soft, cloth-like mass, firmly adherent to the free edge of the valve. Cultures from this mass showed a pure growth of the Klebs-Lœffler bacillus. Sections of the vegetation showed fibrin with pus and coagulated material, with here and there single bacilli which resembled those of diphtheria, but no clumps of bacilli. There were also a few cocci in indefinite arrangement. This was a case of scarlet fever with diphtheritic rhinitis, tonsillitis, and laryngitis, with broncho-pneumonia of both lungs and marked general lymphatic hyperplasia, in a child 2 years old. The Klebs-Lœffler

bacillus was present in the heart's blood, liver, spleen, and kidney.

Inflammation of the middle ear with or without involvement of the mastoid cells occurred in 33 cases of the first group. In 18 it was bilateral and in 15 unilateral. In the double cases the Klebs-Lœffler bacillus occurred in both ears in 16. In no case did it occur in pure culture in both ears. In 3 of the 16 it was present in pure culture in one ear, while the other ear in 2 cases had the staphylococcus pyogenes aureus, and in the third an unknown diplo-bacillus. In 5 cases it was associated with the staphylococcus pyogenes aureus, in 1 with the streptococcus, and in 1 with the pneumococcus in both ears. In the other 5 it was associated with various combinations of the above organisms. In the 17th case it was associated with the streptococcus and the staphylococcus pyogenes aureus in one ear, and in the other ear with the former only. In the 18th case the streptococcus occurred alone in both ears.

In the 15 single cases the Klebs-Lœffler bacillus occurred 9 times. It was present twice in pure culture, with the streptococcus twice, with the staphylococcus pyogenes aureus twice, and in the other 3 cases with various combinations of these organisms. Of the remaining 6 cases, in 4 the streptococcus was present in pure culture; and in the other 2 the staphylococcus aureus and albus occurred.

In the second group the middle ear was involved in 20 cases. In 13 the affection was bilateral and in 7 unilateral. In the bilateral cases the Klebs-Lœffler bacillus occurred 11 times in both ears. It occurred alone once, with the streptococcus twice, and in the other cases with various combinations of the streptococcus and the staphylococcus aureus and albus. The bacillus pyocyaneus was present in 2 cases. Of the 2 cases without the Klebs-Lœffler bacillus the streptococcus was present in both cases, in 1 being associated with the staphylococcus pyogenes aureus in one ear. Of the 7 single cases the Klebs-Lœffler bacillus occurred in 3, alone once, and with the staphylococcus pyogenes aureus twice. The streptococcus was present in the other 4.

It is not to be understood that in the above the organisms mentioned were the only ones present. In some various non-pathogenic organisms were associated with those known to be pathogenic. Several of these were isolated and studied, but none showed pathogenic properties when inoculated into guinea-pigs or rabbits. The presence of these organisms is readily explained by the easy communication with the mouth through the Eustachian tube. This also explains the frequency of the occurrence of the bacillus of diphtheria. The finding of this bacillus in these cases, in the absence of histological examination demonstrating its relation to the process, is insufficient evidence of an etiological relation. It is of interest that many of these cases showed no clinical evidence of ear trouble.

The Klebs-Lœffler bacillus in acute conditions of the middle ear and mastoid has been noted by Councilman (27) in 1 case of diphtheria and 2 of measles (without diphtheria of the throat). Also by Wright (8) in 2 cases, in one of which the streptococcus was also found, and by Stephens and Parfitt (14) in 1 case, in which was the pneumococcus also. Lommel (28) reports 25 cases of diphtheria, in 24 of which there was disease of the middle ear, but in only one was a bacteriological examination made. In this one case the pneumococcus was found. Rimini (48) reports a fatal case of pyemia, the source of infection being a suppuration of the middle ear following diphtheria. "Large numbers of cocci" were found.

Antra of Highmore. — In group I. there was an infection of the antrum on both sides in 7 cases. In all these cases the Klebs-Lœffler bacillus was present in the exudate. Twice it was associated on either side with the staphylococcus pyogenes aureus, once with the streptococcus, once with the pneumococcus, and once with a variety of non-pathogenic organisms. Twice it occurred alone on one side and associated with the streptococcus and staphylococcus pyogenes aureus respectively on the other. In group II. it occurred twice on both sides, once with the Klebs-Lœffler bacillus and various unknown organisms, and once with the streptococcus and staphylococcus pyogenes aureus.

Of the 9 cases, the presence of a definite false membrane was demonstrated in 4, a purulent fluid in 4, and a slightly cloudy serous fluid in 1. In the last case the Klebs-Lœffler bacillus and the pneumococcus were found. In one case in which smears were made from the pus the Klebs-Lœffler bacillus was seen in large numbers, both free and in pus cells. As in the ear, various unrecognized organisms were generally found associated with the known pathogenic bacteria.

This infection of the antra may be one of the explanations of the frequent persistence of the bacillus in the nose after all clinical evidence of diphtheria has disappeared; because the antra drain slowly, and consequently do not so readily become free of the diphtheria bacilli and other organisms and the exudation produced by them. In the literature to which I have had access I can find no reference to this condition complicating diphtheria. Most writers on disease of the antrum consider a " cold " as the chief etiological factor.

The comparatively large number of cases in which it has been observed in this series is due probably to the method of examination. After opening the head and removing the brain in the usual way, the naso-pharynx and adjoining cavities have been examined by Harke's (29) method. This is briefly as follows: The original scalp anterior flap is dissected down over the frontal bone to its union with the nasal bones. The posterior flap is also lengthened by continuing the incision from back of the ears down along the anterior edges of the trapezius muscles to a point below the middle of the back of the neck on either side. The base of the skull is then sawed through in the median line. Posteriorly the base can be entirely divided by sawing at an angle through the bodies of the first three or four vertebræ. In the anterior fossa the separation is completed by the chisel and hammer. The two halves of the skull are then forcibly separated, after which the sphenoidal and frontal sinuses can be examined readily. The distribution of membrane in the post-pharynx and nasal cavities can be studied, and the presence or absence of adenoids. By chipping away the turbinated bones on

either side, the antra are exposed, and can be examined
with little difficulty. The two halves of the skull can readily
be brought together again and easily united with proper wire.
If done with care there is no disfigurement.

This method was not used until the middle of the summer.
If it had been followed in all the cases of this series, there
would have been undoubtedly a larger number of infections
of the antra to report.

Sphenoidal sinus. — In two cases of the first group, a muco-
purulent fluid was found in this cavity. In one in which there
was a general streptococcus infection, this bacterium was
also found in the sphenoidal sinus. In the second there was
a "variety of organisms" with abundant Klebs-Lœffler
bacilli, many of which were degenerate forms.

Thrombosis of lateral sinus, in one case of the first group,
showed the presence of the streptococcus and the Klebs-
Lœffler bacillus. This condition was associated with a mas-
toiditis. There was also a general infection with the same
organisms. Councilman (49) reports a case of diphtheria
developing in the course of typhoid fever in which there was
a purulent infiltration of the sub-maxillary and parotid
glands, with a softened thrombus of the external jugular vein,
and embolic foci of suppuration in the lungs. Cultures
from the lungs showed the Klebs-Lœffler bacillus and staphy-
lococci. Microscopic examination of the thrombus showed
large numbers of the Klebs-Lœffler bacilli and a few cocci.
The abscesses in the lungs had developed around small
branches of the pulmonary artery, and contained the Klebs-
Lœffler bacillus in large numbers. There were also emboli
of the small branches of the pulmonary arteries which were
composed entirely of the Klebs-Lœffler bacillus.

Diphtheritic œsophagitis[1] occurred in two cases of the first
group, and diphtheritic gastritis in one. In all of these the
Klebs-Lœffler bacillus, generally with the streptococcus, was
found in cultures from the deeper layers of the process. In

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[1] One case of group I. and the case mentioned as occurring in group II. have been
previously reported by Dr. T. Leary to the Boston Society of Medical Sciences, June,
1897.

these three cases the bacillus has also been demonstrated in histological preparations. In a case of the second group in which an anatomical diagnosis of diphtheritic gastritis was made, the specific bacillus was found in cultures from the local process and from the gastro-hepatic lymph glands.

Histological examination of this case has not yet been made, so that I do not report it as undoubted. There were three other cases in these two groups which anatomically showed a diphtheritic process in the stomach, and in which cultures showed the presence of the Klebs-Lœffler bacillus, but which have not yet been confirmed by histological examination.

In all of these the diphtheritic process in the respiratory passages was extensive, and in one there was also a general tuberculosis. There was also a general infection, either with the streptococcus, or with the Klebs-Lœffler bacillus, or with both, in each.

The literature contains several references to diphtheritic processes in the œsophagus and stomach; but I have only found one, that of Lœffler (30), in which the bacillus has been demonstrated in section. This method of demonstrating its relation to the process is the only certain one, for the presence of the Klebs-Lœffler bacillus in the stomach as demonstrated by culture is of no significance. In this series in all cases of diphtheria in which cultures were taken from the normal stomach the bacillus was always found, generally in considerable numbers.

Diphtheritic conjunctivitis occurred in one case of the second group. The process was bilateral and the Klebs-Lœffler bacillus was present in abundance. Babes (32) was the first observer to demonstrate the presence of the Klebs-Lœffler bacillus in this process. Escherich (31), Elschig (33), Kolisko and Paltauf (2), and Wright (8) have each reported single cases of this complication. Diphtheritic processes of the conjunctivæ, even those occurring in the course of true diphtheria of the respiratory passages, are not always due to the Klebs-Lœffler bacillus. Flexner (46) reports two cases due to the streptococcus.

Diphtheritic vulvitis and *vaginitis* occurred in one case of the first group. In this there was extensive diphtheria in the respiratory tract. The Klebs-Lœffler bacillus was present in large numbers in cultures from the membrane.

Diphtheritic dermatitis. — In one case, in which there was eczema of the skin of the external ear and mastoid region, following an irritating discharge of the middle ear, which contained the Klebs-Lœffler bacillus, a typical false membrane developed, in which the Klebs-Lœffler bacilli were found in large numbers.

The presence of this bacillus in processes of this nature occurring in the course of diphtheria has been observed in ulcers and abrasions of various parts of the body by Wright (8) in 7 cases (one being fistula in ano), by Neiser (34) in I case (around anus), by Brunner (35) in a case of phlegmon of the scrotum and in 3 inflammatory processes of the fingers, by Spronk (36) in inflammatory tissue around tracheotomy wound (3 cases), and by Park (46) in 2 cases of wound of finger after tracheotomy. Treitel and Abel (46) also report true diphtheritic wound infection. Post (37) has reported I case (in adults) and McCollom (38) 2 cases (in children) of diphtheria of the penis.

Acute abscesses. — In the first group 6 were noted. Three of these were of the cervical glands, in 2 of which were found the Klebs-Lœffler bacillus and the staphylococcus albus. The third was due to the streptococcus and the staphylococcus pyogenes aureus, as was also the retropharyngeal abscess. An abscess of the scalp contained the staphylococcus pyogenes aureus, and one of a bronchial gland, the streptococcus.

In the second group 10 abscesses were examined. Six were of the cervical glands, and in 4 the streptococcus was found in pure culture. In the other 2 the Klebs-Lœffler bacillus occurred, in one associated with the streptococcus and in the other with the staphylococcus pyogenes aureus. A retro-pharyngeal abscess contained the Klebs-Lœffler bacillus, streptococcus, and staphylococcus pyogenes aureus, while a laryngeal abscess contained a streptococcus and the

staphylococcus pyogenes albus. An abscess of the spleen, with an associated peritonitis, was due to the streptococcus, as was also an accumulation of pus over the trochanter of the femur.

It is of interest that suppuration occurred most commonly in the cervical glands. According to Henoch (46) suppuration of these glands occurs in 2 per cent. of all cases. In this series of 157 cases it occurred in about 7 per cent.

These abscesses are generally due to the ordinary pyogenic cocci. Sometimes the Klebs-Lœffler bacillus is also present, as in the abscess of the finger which Wright (8) reports, and that of the larynx reported by M. Koch (39). Leary (40) reports an abscess of the finger, the result of an autopsy·wound, which contained the bacillus of diphtheria in pure culture. According to McCollom (41) abscesses forming at the point of injection of antitoxin are generally ·due to the streptococcus pyogenes.

Acute peritonitis occurred in one case of each group. Both were due to the streptococcus. One was associated with the abscess of the spleen, previously mentioned in group II.

Group III. Seventeen cases of scarlet fever. (Measles also present in 3.)

General infection. — The occurrence of micrococci in the blood and internal organs of fatal cases of scarlet fever was first observed by Crooke (51) in 1885, in 30 cases. Since then Fränkel and Frendenburg (51) have found streptococci in various organs of 3 cases, as has also Raskin (50) in the heart's blood in 4 cases, as well as in suppurating glands and joints. The same observations have been made by Leubartz (51), Kurth (51) and Babes (51), the latter finding it constantly in the kidney. Wright (9) in 11 cases found a general infection with the streptococcus in 4 cases, with the pneumococcus in 1, and a poly-infection with the pus cocci in 1 case (in 2 of these diphtheria was also present). Lemoine (42) in 2 out of 33 cases found the streptococcus in the blood during life. In the urine in each of 22 cases of albuminuria, associated with the disease, he also

demonstrated the same organism; while in 11 non-albumi-
nuric scarlet fever urines he found it only once.   '

Of the 17 cases of group III., cultures from both the *heart's*
blood and *liver* showed the streptococcus to be present in 4
cases.   In the *spleen* it was found twice and the staphylo-
coccus pyogenes aureus once.   In the *kidney* it was found in
5 cases, in 4 of which it was in pure culture, and in 1 it was
associated with the staphylococcus pyogenes aureus.   In a
sixth case the latter organism was present in pure culture.

Broncho-pneumonia was present in 9 cases.   The strepto-
coccus occurred 6 times, twice in pure culture, and with the
staphylococcus pyogenes aureus 3 times.   The latter occurred
alone twice, as did also the pneumococcus.   In the 9th case
there was a combination of several of these organisms.

Netter (43) reports 4 cases of broncho-pneumonia, in 2
of which the streptococcus and pneumococcus occurred.
Queissner (44) reports 4 cases, in each of which the pneumo-
coccus was present, either alone, or with some of the pus
cocci.

Acute pleuritis. — One case was observed, in which the
organism found was the streptococcus.   Lemoine (42) re-
ports 2 cases due to the same organism.

Acute inflammation of the middle ear occurred in 4 cases ;
3 of these were double and 1 single.   Of the double cases,
1 was due to the staphylococcus pyogenes aureus, 1 to the
streptococcus, and in the 3d the streptococcus occurred in
one ear, and the pneumococcus in the other.   In the unilateral
case the streptococcus was present.

Netter[1] reports 1 case of this kind, in which the strepto-
coccus was found.

Acute abscess occurred in 4 cases ; 2 were of the cervical
and 2 of the mesenteric glands.   Of these, 3 contained the
streptococcus, which in 1 (the mesenteric) was associated
with the staphylococcus pyogenes aureus ; and the 4th (cer-
vical) contained the latter organism only.

Netter[1] reports 4 abscesses due to the streptococcus,
occurring in the course of scarlet fever.

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[1] In discussion of Lemoine's paper.

The findings in the above cases indicate the prominent part which the streptococcus plays in the complications and general infection of scarlet fever. The streptococcus found in group III., as well as in the entire series, has been considered as identical with the streptococcus pyogenes. In no case has a streptococcus been found which showed peculiarities of form of growth sufficient to cause it to be considered other than the streptococcus pyogenes.

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A NEW PATHOGENIC CHROMOGENIC BACILLUS.

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The bacillus about to be described came from some rags obtained at a paper mill, located about twenty miles west of Boston.   The sample from which it was isolated was taken from the bottom of a pile which had been in the mill yard for several months, and which had been condemned as a nuisance by the local Board of Health.   Attention was called to the organism by the green color produced in tubes of nutrient bouillon in which the sample had been placed.   A guinea-pig which had been inoculated with about one cubic centimeter of a bouillon culture died within forty-eight hours, and the cultures taken from its heart's blood and from various organs showed, the next day, a distinct green color. Plates were made from these tubes, the organism isolated in pure culture, and studied with the following results:

Morphology. — The bacillus is short and stout, with

rounded ends from 0.9 to 2.8 μ in length and 0.4 to 0.9 μ in diameter; it is frequently united in pairs, but never in chains of more than two elements. Its length seems to depend somewhat on the culture medium on which it is grown; short forms, in which the length does not exceed the breadth (0.9 μ), and which might easily be mistaken for micrococci, are most common on agar media; the long forms are most common on blood serum and potato. In tissues of animals dead from inoculation with the bacillus, the length is about 2 μ, and in such cases it is usually found in pairs.

It stains quickly in anilin colors, particularly well in gentian violet, and is decolorized by Gram's method. It has several flagella, five or less, which are easily demonstrated by Lœffler's method. Spore formation has not been observed.

Biological characters. — It is an actively motile, aërobic, liquefying, chromogenic bacillus. It grows in various culture media at the room temperature, more rapidly in the incubator.

In *gelatin plates* colonies are developed in from 24 to 48 hours, and liquefaction and pigment production begin on the third day. In five days the gelatin is completely liquefied. The colonies are thin, round, and granular, with regular margins, and of a greenish color which fades out toward the edge of the colony.

In *gelatin stick* cultures liquefaction begins in 24 hours, in a deep funnel or saucer shaped depression, constricted at the top, containing toward the bottom a white flocculent precipitate. There is a slight trace of green color in the funnel. In four days the growth has extended to the sides of the tube, then the flow of liquefaction gradually becomes level, and the liquefied portion takes a distinct green color toward the upper surface. A mycoderma forms at the top, and an abundant white flocculent precipitate collects at the bottom of the liquefied area. There is considerable change in the amount of the green color from day to day; some days there is only a little at the top, and other days the green color fills the liquefied area. The green color never

penetrates the unliquefied portion of the tube. In old cultures the whole tube is filled with dark-green liquefied gelatin.

On *agar-agar plates* the superficial colonies grow slowly; in seven days the largest have attained a diameter of two millimeters. The deep colonies of the same age are mere points. Both are granular and regular in outline.

In *agar-agar streak* cultures an abundant, slightly viscid growth occurs along the line of inoculation in 24 hours. The growth is white, with a silvery sheen here and there; is slightly elevated above the surface, with thin, wavy margins; the medium throughout becomes a beautiful light green. In seven days this color becomes a very dark green, almost black.

In *glucose agar-agar* stick cultures a white growth forms on the surface, green pigment appears near the surface, there is very little growth along the puncture, and no gas bubbles form.

In *bouillon* a slight cloudiness appears in 24 hours, with a thin white mycoderma on the surface. In five days the white mycoderma has become green, the medium quite cloudy, and a white, flocculent precipitate gradually falls to the bottom and collects there. In another five days the whole medium has become dark green. On the surface of bouillon cultures grown in flasks the mycoderma is spotted here and there with silvery spots, a centimeter or more in diameter. By shaking a tube or flask containing a bouillon culture, the green color can be made to appear much earlier, but it soon disappears again if the flask or tube is allowed to stand. This phenomenon will be referred to later.

In the *fermentation tube* no gas is produced in ordinary bouillon nor in one per cent. sugar bouillon.

On *blood serum* growth takes place actively, the colonies appearing as small circumvallate spots somewhat elevated above the surface. In eleven days isolated colonies have attained a diameter of three millimeters. The growth is quite viscid. Pigment production begins within 24 hours, at first a light green, but becoming dark, almost black, in

five or six days. In about eleven days liquefaction of the blood serum commences.

On *potato* an abundant, yellowish-white growth occurs in two days, later becoming brownish, and in four days the green color appears, until in about two weeks the whole potato is dark green. The surface of the green growth is marked by many fine parallel lines resembling a thumb print. Frequently the growth on potato shows only the brown color, none of the green pigment being present; this is evidently due to the presence of acid, for the application of an alkali brings out the green color. The "chameleon phenomenon" observed in some forms of bacillus pyocyaneus was not observed.

In *milk* in five days a slight green color appears at the surface and a white coagulum sinks to the bottom, leaving a yellowish medium above. Later the coagulum is digested and a clear white flocculent precipitate extends up through the yellow area, while at the surface a green ring appears. *Litmus milk* is decolorized.

In *Dunham's peptone solution* the growth is similar to that in bouillon. On shaking the tube the precipitate at the bottom arises in a long viscid thread, and the whole medium becomes dark green. All *indol* tests in this medium were negative. In Dunham's solution with *rosolic acid* the color was intensified, showing the production of an alkali.

Relation to temperature. — In all of these culture media the bacillus grows more rapidly at the temperature of the incubator (37.5° C.), and pigment production begins much earlier and proceeds more rapidly than at the room temperature; otherwise the growth does not differ.

Alkali production. — The growth of the organism is attended by the production of an alkali, as is indicated by the rosolic acid solution, and by the reactions of bouillon, peptone, and blood serum cultures to which has been added litmus congo-red, hematoxylin, and phenolphtalein. But perhaps the best proof of this production is the color of the green pigment itself, for this is a remarkably sensitive indicator, the green color only being present in alkaline

media and quickly changing to red under the influence of acids.

Pigment production. — The green pigment is produced in all culture media upon which it has been grown, provided there is free access of oxygen. In gelatin or bouillon cultures, at first the color only appears at the surface, but on shaking the color appears throughout the whole liquefied area. If allowed to stand awhile after shaking, the color again disappears except at the surface. This phenomenon is due, perhaps, to the fact, suggested by Dr. Ernst, that the bacteria have greater affinity for the oxygen than the pigment has, and consequently the oxygen of the pigment is taken up by the activity of the bacteria, and the pigment disappears, to be formed anew when oxygen is again supplied by shaking the flask. This is partially proven by filtered cultures in which the green color is intensified by shaking, and from which the color never disappears except when it gradually fades out under the influence of diffused light, or when it quickly disappears when exposed to direct sunlight. This phenomenon resembles somewhat the "chameleon phenomenon" of other species, and perhaps the same explanation will serve for both. Pigment is formed as abundantly at the room temperature as at the temperature of the incubator, but not so rapidly; it forms as abundantly in the dark as in the light. Cultures have been observed to lose their power of pigment production. It has often occurred that cultures from guinea pigs killed by the germ, when made on Lœffler's blood serum tubes, produced no trace of pigment; but when this white growth was transferred to agar-agar tubes the pigment was abundantly produced, and when transferred back to serum tubes pigment production still went on. Cultures made directly on agar tubes from the animals produced pigment.

The presence of acid or alkali in the culture media seems to have considerable influence on the pigment production. This fact has already been referred to in the description of the growth on potato. Hydrochloric acid in the culture media to the amount of $\frac{1}{4}$ of 1 per cent. inhibits the growth of the

organism altogether. In a smaller per cent of acid and in neutral media, it will grow abundantly and produce pigment; in alkaline media it grows still better up to an alkalinity of $\frac{1}{2}$ of 1 per cent. (NaOH), when growth ceases. In the higher per cents. of alkali, however, there is frequently growth, but no production of pigment. It seems to grow best and produce pigment most abundantly in a slightly alkaline medium.

The pigment has been isolated from cultures and partly studied. If chloroform is added to the cultures, the pigment is taken up by the chloroform and forms a peacock-blue solution, from which the solid pigment may be obtained by slow evaporation. The pure pigment crystallizes in rosettes and egrettes of blue needles. It is soluble in water, alcohol, chloroform, and slightly in ether. It is decomposed by ammonium sulphate. Solutions lose their color and become yellow in four hours' exposure to sunlight. If any water lies above the chloroform, the yellow color enters the water solution and the chloroform becomes colorless. In all its chemical reactions, so far as tested, the green pigment corresponds to the pyocyanin isolated from cultures of the bacillus pyocyaneus; but in its spectrum analysis it has been impossible to find any absorption bands, which are said to be plainly shown in sulphuric acid pyocyanin. There appears to be but one pigment produced in the cultures, while in the case of the bacillus pyocyaneus two or three are present. Further investigations are necessary to determine its character, and to show whether it is identical with pyocyanin or not.

Along with the isolation of the pigment, it was noticed that a peculiarly aromatic substance was taken out by the chloroform. This was found to be present in all cultures. It is remarkably persistent, and remains in all dishes which have come in contact with the chloroform solution for some time. An aromatic substance was isolated from cultures of the bacillus pyocyaneus by Babès.

Pathogenesis. — The organism is pathogenic for guinea-pigs and rabbits when inoculated subcutaneously in doses of $\frac{1}{2}$ a cubic centimeter or more of a bouillon culture three days old.

Smaller doses, 0.3 c.c., occasion a temporary loss of weight in the animals, but no other change, except occasionally a very slight abscess at the point of inoculation.

Filtered cultures, when inoculated subcutaneously, in doses of ½ or 1 cubic centimeter, do not affect the animal, except with temporary loss of weight. Animals inoculated with filtered cultures, or with doses too small to prove fatal, seem to be immune to further inoculations of fatal doses. Just how great this immunity is, how long it lasts, and how much of a dose is required to immunize, remains to be demonstrated.

The pathological changes in the animal organism caused by the subcutaneous inoculation of a fatal dose are an extensive inflammatory edema about the site of the inoculation, infiltration of the subcutaneous tissue of the whole abdomen, an abundant accumulation of serous fluid in the pleural and peritoneal cavities, and, in some cases, many small points of necrosis in the liver and spleen. Smear preparations show the bacilli in great numbers in the serous fluid of the pleural and peritoneal cavities, in the heart's blood, liver, spleen, pancreas, testes, adrenals, kidneys, and subcutaneous tissue. Cultures from all the above organs show the bacilli in pure culture. Sections of the liver, spleen, and subcutaneous tissue show the bacilli throughout the tissue in enormous numbers, apparently spreading from separate foci, which in some cases appear to surround the larger blood-vessels.

———————

This new bacillus resembles the bacillus pyocyaneus in many respects, and perhaps is a closely related form. It differs from it, however, in the following points:

1. It is provided with several flagella scattered over its whole length, while the bacillus pyocyaneus has but one or rarely two at one or both poles.

2. It has never been seen to grow out into chains or filaments of more than two elements, no matter in what culture medium it is grown.

3. The culture media never show fluorescence as do those on which the bacillus pyocyaneus is grown. The color is

always green, with no trace of yellow, and only one pigment can be isolated; from cultures of the pyocyaneus two or three pigments can be isolated.

4. Indol is produced by the bacillus pyocyaneus, while tests of this form were negative.

5. In bouillon cultures this organism produces a cloudy medium with a thick mycoderma, unlike the corresponding changes of the pyocyaneus.

From these facts it will be seen that the organism under consideration differs from all the described varieties of the bacillus pyocyaneus, both morphologically and physiologically, and therefore it must be a distinct and new species.

SOME OBSERVATIONS ON THE URINE AND BLOOD IN DIABETES.

GEORGE S. C. BADGER.

When salol is taken into the stomach, it is not acted on by the acid gastric juice, but is passed on unchanged to the duodenum. Here, in the presence of the alkaline pancreatic juice, it is split up into salicylic acid and phenol. The salicylic acid is excreted in the urine as salicyluric acid, its presence being easily detected by the addition of ferric chloride, a purple color being obtained. Gley has shown, however, that after removal of the pancreas, salol is nevertheless split up, probably by the intestinal juices; most writers attribute the splitting up of salol to the action of the pancreatic juice.

The observations I have to report were made on three diabetic patients, with twelve non-diabetic patients as controls. The object of the experiments was to determine, if possible, whether the pancreas was diseased or not. At least, one of the three diabetic patients might justly be considered to be suffering from pancreatic diabetes. He was young, had lost seventy pounds in three months, and was excreting from four to ten per cent. of sugar a day, in spite of restricted diet. Another case entered the hospital with eight per cent. of sugar in his urine. Under treatment the percentage was reduced to less than one per cent. The third case was a mild

one, in a stout Jewess, her daily average being less than one per cent. of sugar, and at times the sugar disappearing entirely.

The control experiments were made on the following cases: 1. Acute articular rheumatism; 2. Sciatica; 3. Chronic gastritis; 4. Neurasthenia; 5 and 6. Pulmonary tuberculosis; 7. Malaria; 8. Splenic myelogenous leukemia; 9. Acute pericarditis; 10. Pancreatic cyst (?) (thought to be this at time of operation); 11. Carcinoma of stomach; 12. Aneurism of the aorta.

The Urine in Diabetes.

The method used was as follows:

Salol in gr. xv doses, in capsule, was given every four hours until ʒ j was given. The urine was collected four hours after the first dose, and every four hours thereafter, until the reaction for salicyluric acid in the urine disappeared. In every case the color of the urine was noted, the presence of salicyluric acid, and the presence of sulphates determined, also the duration of the salicyluric acid in the urine.

The test used to determine the presence of salicyluric acid was as follows: To one specimen of urine was added ferric chloride. If a purple color was obtained, another specimen of urine was thoroughly boiled, and ferric chloride added. If the purple color was still obtained, the reaction was thought to be due to salicyluric acid. Had it been due to diacetic acid, the thorough boiling would have prevented the reaction. To determine the presence of sulphates, the barium chloride mixture was used. The sulphates were roughly quantitated by noting the depth of the precipitate in the test tube. If it filled one-half the concavity of a test-tube, the quantity was considered normal.

My results were as follows:

Four hours after the first dose of 15 grains of salol, a very slight smoky tint was noted in the urines of the two milder diabetic patients, and in the urines of four other patients; namely, of chronic gastritis, neurasthenia, pulmonary tuberculosis, and aneurism of the aorta. Eight hours after the first dose of salol, or four hours after the second dose of 15

grains, eleven urines were more or less smoky. In the case of the carcinoma of the stomach, the urine was at no time smoky. All three diabetic patients showed a distinctly smoky urine. The urine from the patient supposed to be suffering from pancreatic cyst was almost black.

Four hours after the first dose of salol, all the urines but three showed the presence of salicyluric acid. These three were acute pericarditis, pulmonary tuberculosis, and carcinoma of the stomach. In the diabetics the reaction was strong. The presence of salicyluric acid was noted in all the cases to disappear in from twenty-four to twenty-eight hours after the last dose of 15 grains. In two instances, however, in two of the diabetic cases, the reaction persisted for thirty-six hours. This occurred in the severe case and in the case of the stout Jewess.

In only two or three instances were the sulphates notably diminished; namely, in acute articular rheumatism, in malaria, and in the pancreatic cyst cases. In these the urine was distinctly smoky. Many of the most smoky urines, however, showed no notable diminution in the sulphates.

It seems, then, that, in the three cases of diabetes experimented on, salol was split up as rapidly and as completely as in the non-diabetic cases; that in the severe case of diabetes this reaction was as marked as in the less severe. In two instances, to be sure, there seems to have been a slow elimination of the salol, but on other occasions this fact was not noted. The salol test, as a means of gaining information concerning the condition of the pancreas, seems of little value, at least in cases of diabetes.

The Blood in Diabetes.

In 1894 Ludwig Bremer, of St. Louis, called attention to the peculiar staining qualities of diabetic blood. In his first communications he advised the use of a mixture of methylene blue and eosin, prepared in a very careful manner. The cover slips were thinly spread with blood, and heated for two hours at a temperature of 120°–125° C., and then exposed to the stain. Normal blood showed the red corpuscles to be

stained a reddish-brown, whereas the red corpuscles of dia-
betic blood took on a bluish-green color.   This reaction I did
not try.

In a later communication he discarded this tedious and
uncertain method, and adopted a very simple one. The
blood slides are made thick, heated to 135° C., and exposed
for a few minutes to a 1 per cent. aqueous solution of congo
red or methyl blue.   Diabetic blood does not stain at all, or,
on long exposure, stains slightly, whereas normal blood takes
the yellow or green-blue stain distinctly.   This reaction, he
claims, is present in all cases of glycosuria, and will persist in
true diabetes, even after all sugar has disappeared from the
urine.

My own observations were made on the blood of 7 dia-
betics.   Of these, 4 were mild cases, 3 severe. In every
instance the reaction was pronounced.   The slides of diabetic
blood did not stain at all, or took a dirty-yellow color or
green color, in marked contrast to the slides of normal blood.

One of the cases was that of a glycosuria complicating a
nephritis.   The percentage of sugar was about 1 per cent.,
yet the reaction was very distinct.   In another case, after the
sugar had disappeared from the urine, the reaction still per-
sisted.   In yet another case, whose sugar at entrance to the
hospital was 8 per cent., and a few days later, on restricted
diet, was less than 1 per cent., the reaction on the two days
was positive and without appreciable difference.

With Biebrich's scarlet, the reaction, according to Dr.
Bremer, is just the reverse. Diabetic blood takes the stain;
non-diabetic blood remains unstained.   This reaction I could
not confirm.

Lépine and Lyonnet claimed for the blood of splenic myel-
ogenous leukemia the same reaction as with diabetic blood.
Bremer says this is true only of the very alkaline methylene
blue and eosin method.   In four cases of splenic myel-
ogenous leukemia I failed to obtain the reaction with
congo red or methyl blue.   The leukemic blood stained
exactly as normal blood.

Dr. Fitz mentioned to me that some one had claimed the

same reaction for the blood of patients suffering from exophthalmic goître.   In two cases of this disease I tried the reaction, and found that it was present exactly as in diabetes.   That is, the blood of Graves' disease (or exophthalmic goître) does not take the stain when a 1 per cent. aqueous solution of congo red or methyl blue is used. Slides of diabetic and Graves' disease blood, stained with congo red or methyl blue, cannot be told apart.

In the "British Medical Journal" of September, '96, R. T. Williamson described a method for diagnosticating diabetes by examination of the blood.   The method is simple.   Diabetic blood will decolorize methylene blue or methyl blue in an alkaline medium.   The exact technique is as follows:

Take 40 cmm. of water, 40 cmm. of potassic hydrate of a specific gravity of 1058 (that is, about a six per cent. solution), 20 cmm. of diabetic blood, and 1 ccm. of an aqueous solution of methyl blue or methylene blue, 1:6,000; mix carefully and place in boiling water without shaking.   At the end of three or four minutes it will be found that the blue solutions have been decolorized, the solutions being now of a yellow color.   Shaking the tubes during the boiling prevents the reaction.   If the tubes are shaken after decolorization has taken place the blue color reappears.

This reaction was tried in five cases of diabetes, using as controls the blood of a leukemic patient, of a patient suffering from Graves' disease, and the blood of a normal individual.   The reduction of the blue color was noted only in the cases of diabetes.

When methyl blue was used, the strength of the solution being 1:6,000, the color of the mixture, after the addition of the blood, was not a blue, but a clear reddish-yellow, whether the blood was of a diabetic or of a non-diabetic patient.   Now, on placing these tubes in boiling water, the tubes of diabetic blood turned a dirty-yellow color; the tubes of non-diabetic blood in every instance remaining a clear reddish-yellow. The reaction was distinct, and easy of recognition.

When methylene blue was used the reaction was much more striking.   The color of the solution, after the addition

of blood, is a deep greenish-blue; but after boiling for three
to four minutes, the solutions containing diabetic blood
turned a yellow color, those containing non-diabetic blood
remaining unchanged, or becoming a little lighter blue. This
reaction was obtained in only two cases of diabetes; it was
not obtained in one case which, nevertheless, gave a positive
reaction with methyl blue.

Williamson gets these same reactions with the urine of
diabetic patients. That is, instead of using 20 cmm. of
diabetic blood, he uses 20 cmm. of diabetic urine.

The reaction with the diabetic urine was more interesting
even than with the blood. Under the same conditions as
with the blood, the blue color in every instance disappeared
from the solutions containing the diabetic urine; when
placed in boiling water, normal urine and the urines of three
patients not diabetic in no case decolorized the solutions,
when the exact amounts of the ingredients were taken.
After decoloration, on shaking the tubes the blue color
returned. On reboiling it did not disappear again, unless
more urine was added.

It seems most probable that this reaction, with both blood
and urine, is due to the presence of sugar. To determine
this, the sugar was fermented out of a diabetic urine, the
urine filtered, the filtrate tested by Fehling's solution, and
found to contain no sugar. With 20 cmm. of this filtrate,
no reduction of color took place after boiling four minutes.

A watery solution of grape sugar, of a strength of 1 per
cent., used in place of urine, reduced the solutions exactly
as did diabetic urine.

Diabetic urine, whose coloring-matter had been precipi-
tated by basic acetate of lead, but which still contained
sugar, gave a positive reaction.

It seems to me, then, judging from the above experiments
made on the urines of three diabetics, that the reduction of
the blue color is due to the presence of grape sugar. Just
how much grape sugar is necessary to reduce the blue color
I do not know. But since normal blood contains some
sugar, it would seem that if enough blood were used there

might be sufficient sugar present to bring about a reduction of the blue.   And this is borne out by facts; for if, instead of taking 20 cmm. of normal blood, we take 60 cmm. the reaction is obtained.   This I proved, using my own blood for the test.

The value of these reactions, from a clinical standpoint, seems to me slight.   They are very interesting, but not particularly valuable.   None of these tests are so simple as the Fehling's test for sugar in the urine.   True diabetes cannot be differentiated from temporary glycosuria.   By Bremer's method, diabetes is not differentiated from Graves' disease.

Why diabetic blood has a different staining reaction from non-diabetic blood has not been determined positively.   The best explanation seems to me to be that there is a change in the protoplasm of the red blood corpuscles.   I do not think this reaction is due to an excess of sugar in the blood. Certainly an excess of sugar in the blood cannot explain this reaction as it occurs in Graves' disease.

SPECIAL NOTICE.

The Journal will be published *immediately* after the meetings of the Society, and will contain authors' abstracts of the papers presented, when these papers are not given in full.

By general consent of the Heads of Departments it will contain full abstracts of experimental work carried on in the following institutions: the Medical School of Harvard University, the Experiment Laboratories of the Massachusetts General and the Boston City Hospitals, the Physiological and Biological Departments of the Massachusetts Institute of Technology, Clark University, and the Anatomical Laboratory of Brown University.

Papers and abstracts of papers upon subjects connected with the Medical Sciences will be welcomed from persons not members of the Society, and if approved by the Council will be presented at the meetings, and will be given a place in the Journal.

When desired, the insertion of papers, if in abstract, will be accompanied by a note indicating the place where they may be found in full. Fifty reprints will be furnished free to authors if the desire for them be expressed on the manuscript.

Subscribers to the Journal are invited to attend the meetings of the Society; the next will be held on March 15 and April 19, at the Harvard Medical School, at 8 P.M.

All communications should be addressed to the Editor,

<div align="center">

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CONTENTS.

At the meeting of March 1, 1898, the following com-
munications were made:

ON THE DEVELOPMENT OF THE INTESTINE OF THE CAT.

FRANKLIN DEXTER, M.D.

(*Assistant Professor of Anatomy, Harvard University Medical School,
Boston, Mass.*)

The development of the human alimentary canal has been
very thoroughly studied by Toldt, Hertwig, Klatsch, and
Mall. As far as I know nothing has been written on the
development of the intestines of the cat, although the adult
anatomy of this animal has been described by Mivart, Bon-
net, Wilder, and others.

Its abdominal cavity differs in several respects from the
human subject. In the first place, there is a remarkable
lacking of all adhesions between the viscera and the abdomi-
nal walls. The duodenum forms a long, extensive loop,
which might well be described as consisting of four portions,
as is customary in the description of the human duodenum.
The appendix is absent. The ascending colon is rather
short, the transverse colon is well developed, and terminates
in the descending colon. The transverse colon differs mate-
rially from the human transverse colon in that it lies behind
the different coils of jejunum and ileum, instead of in front of
them. The absence of all adhesions, and the short ascend-

ing colon, at once suggest an embryonic type of abdominal cavity.

Method of Investigation.

This investigation was made by means of microscopic sections, as well as by the dissection of twenty-three embryos, several of which were very kindly sent me by Professors Wilder and Gage, of Cornell University.

Intestines Extra-abdominal.

For some time it has been recognized that at a certain period in the development of the human embryo certain parts of the intestines lie outside of the abdominal cavity proper, within the cavity of the umbilical cord. They remain here for a certain space of time, and then enter the abdomen. It seems to me that until recently the importance of this phenomenon has not been appreciated, for the literature on the subject amounts to almost nothing.

Mall, in a recent article, states that this phenomenon occurs in pigs as well as in the human species.

I have observed it in cats, dogs, and rabbits.

Mall attributes the cause of the exit of the intestines to the descent of various abdominal organs, as well as to the great growth of the liver.

I have certain microscopic sections which show conclusively that in the cat the enormous size of the liver forms the chief factor in the expulsion of the intestines.

The fact is, the liver grows so rapidly and to such an inordinate size that it entirely fills the abdominal cavity, and so the intestines are forced to lie in the cavity of the cord.

Mall was unable to give a reason for the entrance of the intestine into the abdomen of the human embryo, and thus far I have been equally unsuccessful in the cat.

I do, however, believe that there is a definite order of entrance.

The duodenum, the first bit of jejunum, as well as the lower portion of the colon, are always to be found within the abdomen. On the other hand, the greater part of the jejunum, the ileum, cæcum, and the upper part of the large

intestine may be readily recognized while in their extra-abdominal position.

Their entrance seems to me to occur in the following order: There seems to be a simultaneous entrance of the two extremes of the intestine, the jejunum, and colon. The cæcum seeks at once the pyloric end of the stomach, and lies in the median line just below and close to it, with its mesenteric border facing posteriorly, and this seems to be its normal position until all the intestines have entered the abdomen. The jejunum usually forms a simple loop toward the right side of the embryo. The remaining part of the jejunum now enters the abdomen, next follows the ileum, until finally the last piece of intestine to enter is a bit of the ileum situated about a centimetre from the cæcum. The date of entrance of the intestine varies to an enormous extent.

Development of Ascending and Transverse Colon.

Soon after the intestines have all entered the abdomen the cæcum turns so that its mesenteric border faces inferiorly instead of posteriorly, but it still lies close to the pylorus, in the median line.

The last bit of the ileum occupies the position of the future ascending colon, while the colon winds around the termination of duodenum and commencement of jejunum, and then seeks the median line, to terminate in the rectum.

The stomach changes its position more to the left of the embryo, and the cæcum follows it, always lying close to the pylorus and now situated distinctly to the left of the median line.

During the period of change in the position of the stomach and cæcum there must necessarily have been almost no increase in the length of the colon. The cæcum is unquestionably forced to follow the stomach to the left, by the pressure of the jejunal loop (formed by the first bit of jejunum) against the right side of the colon.

The colon now begins to grow rapidly. The kidney, the great omentum and spleen, prevent its further growth to the left.

The stomach interferes with its upward growth, the coils of small intestine lie in front of it, and the fixed point of junction of the duodenum and jejunum obstructs its bodily movement to the right.

The cæcum has no choice but to grow in a transverse direction, and thus the transverse colon is formed.

In the growth of the cæcum to the right it now meets the descending or second portion of the duodenum.

At this stage the duodenum, as well as a great portion of its mesentery, is resting upon a part of the right lateral lobe of the liver, which raises the duodenum, and so its mesentery makes an inclined plane, sloping to the left.

The cæcum, in its growth, first meets this inclined plane and then meets the duodenum, which obstacles prevent its further growth to the right.

It cannot turn upward or forward on account of the liver, and so it is forced to grow downward parallel and to the left of the second portion of the duodenum.

In the adult cat the lateral lobe of the liver, above referred to, atrophies to such an extent that its relation to the duodenum is of little importance.

Consequently we find the cæcum to the right of the median line, close to the second portion of the duodenum, and slightly in front of it. The commencement of the transverse colon is covered by the liver. The stomach has developed in a downward direction so that in the adult it also lies in front of the transverse colon.

In a subsequent paper I hope to consider more in detail the development and the growth of the liver, stomach, and small intestine.

A CASE OF MYCETOMA (MADURA FOOT).

JAMES H. WRIGHT.

(From the Laboratory of the Massachusetts General Hospital.)

The patient was an Italian woman, aged twenty-six, admitted to the service of Dr. H. H. A. Beach, in the Massachusetts General Hospital, Dec. 29, 1897. The tissues of the left foot in the region of the base of the second and third

toes on the plantar aspect presented a swollen appearance with desquamation of the epidermis.

In the skin over this swollen area there was a small sinus from which there exuded on pressure a dirty, purulent fluid containing black, irregular granules, like grains of gun-powder. On the dorsum of the second toe near its tarso-metatarsal joint there was a small ulcer.   The disease began in July, 1897.   The patient had lived in America for several years.

A piece of tissue was excised from the second toe for microscopical examination, and from the results of this, as well as from the presence and character of the black granules in the pus, the diagnosis of mycetoma or madura foot of the melanoid variety was made.   Amputation of four toes, together with a part of the four corresponding metatarsal bones, was performed by Dr. Beach.

The dissection of the amputated part showed the follow-ing conditions: In the soft tissues of the plantar surface of the foot near the tarsometatarsal articulations, and imme-diately beneath the skin, was a pigeon's-egg sized ovoid tumor mass, sharply defined from the surrounding tissue by a faintly indicated connective tissue capsule.   This mass on section consisted of a soft, in places gelatinous, myxoma-tous-looking tissue, traversed by a reticulum, which divided it into ill-defined small areas, and in these areas small, black, irregular granules like gunpowder grains were present. These grains occurred singly and in groups.   The tumor mass in one or two places also presented opaque yellow areas.   Two other similar nodules of small size were also found.   One was situated in the soft tissues of the dorsum of the foot near the base of the second and third toes, the other in the soft tissue of the first phalanx of the second toe. The larger of these nodules was of about the size of a pea. The bones were not involved.

Histology.

The results of microscopical examination of the tumor masses showed that the process was one of a typical granula-

tion tissue formation followed or accompanied by suppuration, and closely associated with the presence of the black granules before mentioned. These black granules appeared in the sections as irregular outlined, brown-colored masses of indefinite structure. The main mass in some instances was suggestive of a very closely woven, branching, brown-colored hyaline mycelium; in other instances little more than closely packed hyaline brown granules could be made out. The central portion of the masses in some cases was less dense than the periphery, and made up of amorphous or indefinite material. In a very few of the brown masses, a few strands of what seemed to be typical fungus mycelium were observed. In some of the masses a narrow radiately striated margin was present. The brown masses stained well with aniline dyes.

Cultures.

About 65 of the black granules were planted in various culture media, and from about 25 of these there developed a growth of long, branching filaments. In fluid media the growth had the macroscopic appearance of a white puff-ball, with the black granule in the centre, and attained a diameter equal to that of the test-tube. Microscopically the growth consisted of very long, branching filaments, much thicker than the filaments of actinomyces, radiating from the black grain as a centre. These filaments showed hyaline circular areas and delicate transverse septa.

On solid media the growth also consisted of long, grayish filaments radiating from the black grain as a centre. These eventually formed a dense mycelium. No hyphæ or spore-bearing organs were observed.

The organism stained· with the aniline dyes. The inoculation of guinea pigs and fowls gave no definite results.

PLATE I. — 1. Culture in bouillon, showing "puff-ball" appearance with black grain in centre of growth.

2. Mycelial growth from black grain of original material. (Zeiss aa₂.)

FIG. 1.

FIG. 2.

ON THE NATURE OF CERTAIN FOOD STUFFS RECOMMENDED IN THE TREATMENT OF DIABETES.

CHARLES HARRINGTON.

(From the Laboratory of Hygiene of the Harvard Medical School.)

Some years ago the writer collected and analyzed every form of so-called diabetic foods which were on the local market. They were all advertised as being strictly non-starchy and admirably adapted for the making of bread for the dietary of diabetic subjects. The results, published at the time in the " Boston Medical and Surgical Journal," showed that they were one and all gross frauds, so rich in starch that one might better use ordinary bread, with its advantage of superior palatability.

From time to time other preparations, like the former claiming to be pure gluten, which, by the way, cannot be made into bread; have been examined with similar results.

Recently five other preparations have been examined, two of which surpass all others ever analyzed in yielding evidence of the rascally greed for gain which is the moving power of unscrupulous manufacturers.

Three of the five were submitted by a member of the medical staff of one of our large hospitals, where their use had been advocated, and a fourth had been recommended to his favorable consideration. The fifth was noticed in the show window of an establishment devoted to the sale of " Health Foods."

1. "Perfect Food for Diabetics."

This is guaranteed to contain less starch than any diabetic food in the market.

Percentage of starch $= 56.25$.

2. "Vegetable Gluten."

Percentage of starch $= 71.10$.

3. "Poluboskos."

This preparation, the name of which, according to the accompanying circular, is derived from the Greek, signifying

" much nourishment," claims to contain less than one-half of one per cent. of starch. With each package, which is unusually expensive, is a copy of an analysis by a chemist of repute certifying to this low content of carbohydrate. Whatever may have been the nature of the sample upon which his analysis is based, the fact remains that the substance now on sale contains 21.42 per cent. of starch.

4. " Soja Bean Meal."

This and the following are the two specimens particularly mentioned above as extra fraudulent in character. It might be claimed by the manufacturers of the others that their products, being made from wheat, were as free from starch as they could make them. They might properly claim that they would not intentionally add the substance as an adulterant that they desire to eliminate. This claim, however, can hardly be maintained in the case of these two.

The Soja bean contains comparatively little starch, and on this account has been recommended as a substitute for the more starchy foods. The sample in question contained not only its natural starch, but enough added wheat flour to bring its total percentage of starch to 26.67.

5. Almond Meal.

The almond is rich in nitrogenous matter and fat, and free from starch. When dried it becomes brittle, and is easily reduced to a meal which is quite palatable.

The specimen examined was most suspicious in appearance and odor. It possessed a fragrance which was so strong as to suggest the addition of some agent designed to convey the impression of absolute genuineness, and at the same time to suggest that this addition had been overdone.

Microscopical examination showed little else than wheat starch, and chemical analysis showed the presence of this material to the extent of 68.72 per cent., a figure slightly in excess of the average of starch yielded in the analysis of 200 specimens of whole wheat. Further comment is unnecessary.

ONE OF THE CONDITIONS UNDER WHICH DISCONTINUOUS STERILIZATION MAY BE INEFFICIENT.

THEOBALD SMITH.

(*Fabyan Professor of Comparative Pathology in the Harvard Medical School.*)
(*Abstract.*)

After the discontinuous steaming of bouillon in shallow layers necessitated by the demands for oxygen of the diphtheria bacillus, anaërobic bacilli frequently appeared subsequently as contaminations of the cultures. Such bouillon, before inoculation, remained indefinitely clear, even in the thermostat. Some days after diphtheria bacilli had been introduced, disagreeable odors indicated contamination, and the microscopic examination of the culture fluid and subcultures therefrom revealed spore-bearing anaërobes. The spores were unable to germinate in the otherwise sterile bouillon, owing to the aërobic conditions. As soon as the diphtheria bacilli had formed a surface pellicle, conditions favorable to anaërobiosis were established beneath it.

By placing the bouillon under conditions favorable to anaërobiosis during the period of discontinuous sterilization, the latter method may still be employed. This was accomplished by steaming the bouillon in round litre flasks filled to the neck. By means of this procedure, anaërobes, though occasionally spoiling the bouillon after three steamings, were eliminated. This roundabout method demonstrated the occasional presence of living spores of anaërobes after three steamings, 24 to 48 hours apart, and their capacity to germinate without assistance from other bacteria in the full litre flasks. At no time were aërobic spore-bearing bacilli found to survive discontinuous steaming. The difficulty can be entirely avoided by using the autoclave, provided the high temperature does not reduce the nutritive qualities of the bouillon. All the bacilli encountered bear round or oval spores at one end of the rod. They probably belong to several species and are reserved for systematic study.

The source of the spores may be the dirt and fecal matter with which the beef comes in contact at the abattoirs.

Another source is probably the beef itself, into which spores may be carried through the blood from the digestive tract during life. Such spores, according to Wyssokowitz, may live a long time in the organs. This view was suggested by the appearance of anaërobes in fermentation tubes inoculated with pieces of spleen, liver, and kidney from healthy animals.

CHRONIC (OR HEALED) DISSECTING ANEURISM OF THE AORTA ACCOMPANIED BY AN ACUTE DISSECTING ANEURISM WITH RUPTURE INTO THE PERICARDIUM.

W. H. PRESCOTT.

Miss F. S., 41, single, 5 ft. 10½ in. in height; weight, about 150; an artist. Previous and family history negative; no venereal history. Had been under treatment at various intervals for several years for fibroid of uterus.

The heart sounds were always negative, but an indefinite bruit was heard over the xiphoid cartilage during life.

Diagnosis, dissecting aneurism of the aorta. Death occurred April 11, consciousness being retained until within two minutes of her death.

Autopsy, 24 hours post-mortem. Body large, well nourished. Rigor mortis present. Lividity of dependent portions. Peritoneum normal. Stomach normal. Intestines normal. Bladder normal. Suprarenals normal. Liver large, dark; blood-vessels injected. Kidneys normal, except the blood-vessels are injected. Spleen large and firm. Multiple fibroids of the uterus. Head and spinal column not opened.

Cultures from heart, lungs, and inflamed area of the pericardium showed colon bacilli and staphylococcus albus.

The pericardial sac contained about 750 cc. of fluid and clotted blood. The pericardium was smooth, save for a space along the pericardial portion of the aorta; here the wall was roughened by a slight fresh fibrinous exudation.

In the centre of this exudation there was an irregular loss of pericardium, through which a small probe could be passed into the subpericardial tissue, which was infiltrated with blood.

Underneath this hemorrhagic area was the cavity of a dissecting aneurism.

Heart large, weight 450 gms.; left ventricle hypertrophied, its cavity slightly dilated; mitral valve dilated 12 cm. in circumference; other valves normal. (Specimen shown.) Coronary arteries given off high up in the sinuses of Valsalva, and their walls are thickened. The sinuses of Valsalva are greatly dilated, forming pouches 3½ cm. deep, and the largest (which is the one corresponding to the right coronary artery) is 4 cm. in diameter. Aorta, above valves, 8½ cm. in circumference; its surface is whitish with gray gelatinous plaques rather evenly distributed; but there are no typical elevated plaques of endarteritis. Immediately above the valve, corresponding to the left coronary artery, there is an irregular angular rent in the intima, each side of which is 6 mm. in length. One edge of this rent passes directly through the intima into a cavity behind. The other edge is torn obliquely, and there is a slight membrane covering part of the tear. This opening in the aorta passes into a cavity (filled with fresh and clotted blood) which is around the outer convex portion of the aorta, and surrounds it with the exception of an area 4½ cm. in diameter. This cavity is separated from the adjacent tissues by a thin membrane in which cross striations can be distinctly recognized. Cavity passes along the inner wall of the aorta down to and partly into the substance of the heart. Its wall is pinkish-red; the inner wall is infiltrated with blood corresponding to the infiltration observed in the pericardium.

The aorta within the cavity is white and opaque, and is crossed by numerous small ridges apparently corresponding to the muscular fibres. A small bit taken from the convex portion of the aorta, and also one from the cross striations previously mentioned, and examined microscopically showed muscular fibres and fatty degenerated tissue. This sac continues up to the innominate artery and completely surrounds that artery for a distance of 1 cm. from its origin. It then passes just beyond the left subclavian artery to within ½ cm. of the opening of the second sac, where it communicates with the aorta by a rent 1½–2 cm. long.

There is a second sac which begins 1½ cm. from the sub-clavian. This sac extends down along the posterior wall of the aorta for its entire length. It then continues along the posterior wall of the left common iliac, and communicates with this artery by a small hole 1 cm. long and quite narrow. Upon slitting up the sac the openings of the intercostal arte-ries were seen in the posterior wall of the aorta, and openings in the sac to correspond were also seen, from which the arteries proceeded. The surface of the sac is perfectly smooth and glistening; no fibrin is present. On section, the wall is 1½ mm. thick and of a grayish transparent color. At the upper portion of the sac (2 cm. below its upper angle) there is a perfectly smooth opening 8 mm. in diameter which communicates with the aorta. In the portion above the opening the wall is red and soft, and covered with a thin layer of fibres, and easily detached. The two renal arteries pass from the aorta along the sac, but do not open into it. The inferior mesenteric artery opens directly into the sac.

The inner lining of the aorta appears to be of precisely the same character as that of the aneurismal sac.

Description of microscopical section, stained with phospho-tungstic acid and hæmatoxylin: section of wall of abdominal aorta in vicinity of aneurism shows the intima thickened, com-posed of dense tissue with few cells. The media are extremely irregular. The elastic laminæ are to a great extent broken up and extremely irregular, often turned on themselves in places; reduced to a very small amount and extremely thin. Between the elastic laminæ the muscular fibres are irregular, have in large part disappeared, and their places are taken by dense connective tissue, with but few cells. The muscular fibres close beneath adventitia are better preserved. Con-tinuing along the artery between it and the aneurism, in one place the elastic laminæ have entirely disappeared. All along here there are various distinct breaks in the elastic tissue. The edges of the fibres in the broken places are separated and irregular. At the line representing the junc-tion of the aneurism with the aorta there is great irregularity in the elastic tissue. There are fragments of it here in the

tissues.   Along the entire outer wall of the aneurism there is a varying amount of elastic tissue, in some places more, in others less.   Muscular fibres can be distinguished every place here on the outside.   The inner wall and almost the entire thickness of the aneurism are composed of a dense hyaline and fibrous connective tissue, with but few cells and no elastic tissue and no muscular fibres.   It is a tissue of the same sort as that forming the thickened intima of the aorta.   On the inner surface of the aneurism at places a definite lining of spindle-shape endothelial cells can be made out, but generally this is absent.

The endothelial lining, if it be such, is more evident on the wall of aneurism than on the artery itself.   Microscopical examination shows that the walls of the aneurism are formed by the aorta and it has resulted from a hemorrhage into the media of the artery close to the adventitia.   It is probable that preceding the aneurismal formation there was more or less degeneration of the entire artery, with numerous ruptures of the elastic membrane.   [For the clinical report of this case I am indebted to Dr. Joseph C. Stedman, of Jamaica Plain.]

THE BACILLUS CAPSULATUS (BACILLUS PNEUMONIÆ OF FRIEDLANDER?), WITH SPECIAL REFERENCE TO ITS CONNECTION WITH ACUTE LOBAR PNEUMONIA.

JOSEPH J. CURRY.

(*Assistant in Pathology, Harvard Medical School.*)

(*Abstract.*)

The twelve cases in which this organism was found were as follows :

Case I.   Acute lobar pneumonia.   The capsule bacillus was found in cultures of the lung along with the diplococcus lanceolatus.   The growth of the capsule bacillus was so profuse in the cultures that it obscured the growth of the diplococcus.   Sections of the lung showed the capsule bacillus chiefly in the bronchi, and the diplococcus lanceolatus in the alveolar exudate, and on the pleura.

Case II.   Acute endocarditis, with gangrene of lung.   Capsule bacillus found in pure culture in the heart vegeta-

tions, and with other organisms in the gangrenous cavity. In both these cases pure cultures of the capsule bacillus were found in the internal organs.

Case III.   Acute croupous pneumonia complicated with acute otitis media.   The bacillus capsulatus and the diphtheria bacillus were found in cultures made from the middle ear.   The micrococcus lanceolatus in the lung, heart's blood, and kidney, but not in the middle ear.

Case IV.   Fracture of the skull, accompanied by acute otitis media.   The capsule bacillus found in pure culture in middle ear.

Cases V., VI., VII., VIII., X., XII.   Diphtheria.   Capsule bacillus obtained from the throat.

Cases IX. and XI.   Tonsillitis.   Capsule bacillus obtained from the throat.

In one of the diphtheria cases the capsule bacillus and diphtheria bacilli were found in pure culture.   In the nose there were no capsule bacilli, but an abundant growth of diphtheria bacilli.   In the cultures from the throat, the capsule bacilli grew so profusely that the diphtheria colonies could not be made out.   Diphtheria bacilli in small numbers were seen only after smearing from the general surface of the tube, and in the water of condensation.   The growth of the capsule bacilli in the throat cleared up in a few days.   Then the diphtheria colonies grew luxuriantly.   In another case, the growth of the capsule bacillus persisted some time after the growth of the diphtheria bacillus.   Inspection of the throat showed the mucous membrane of the pharynx to be congested and granular.   It was covered with a thick, glairy, opaque, sticky material, closely resembling the diffuse growth of the capsule bacillus on blood serum.   This material, when touched with a platinum loop, would draw out in long threads.   Three other cases showed the same condition of the throat, but not so marked.   In the six diphtheria cases in which the capsule bacillus was found, the disease in every case was mild.   The two cases of tonsillitis presented no unusual symptoms, and recovered after a few days. Weichselbaum, in 1888, reported a case of endocarditis due

to a capsule bacillus closely resembling the case reported here.

Cultures and inoculation showed the bacillus in each of the twelve cases to be the same.

Subcutaneous inoculation of guinea pigs was fatal in from 5 to 7 days.   Intra-peritoneal injection was fatal in 24 hours.   The organism was recovered from the blood, and from the various organs.   The lymph glands are enlarged, the spleen is large and soft, the blood somewhat thickened, but not to the degree described by Pfeiffer in his experiments with the capsule bacillus.   The adrenal glands were hemorrhagic.   The organism seen in these twelve cases is closely related to, if not identical with, the capsule bacilli described by Friedlander, Wright and Mallory, and Pfeiffer.

Fasching, von Dungern, Morri, Mandry, Abel, Paulsen, and Marschand have described capsule bacilli differing from ours only in minor detail, and many of them are probably identical.

For stainingt he capsules the following method, which is a modification of the method given by Welch for staining the capsules of the diplococcus lanceolatus, gives the best results.

1.   Cover the preparation with glacial acetic acid for a few seconds.

2.   Wash off the acetic acid with a 1 per cent. solution of potassium hydroxid.

3.   Stain with aniline gentian violet for one minute without previously washing off the potassium solution.

4.   Wash off excess of stain quickly in water.

5.   Dry thoroughly with filter paper and over low flame, and mount in balsam.

This method also gives good results in staining the capsules of the micrococcus lanceolatus.   The writer has specimens which have remained stained after two years.

The connection of this organism with acute croupous pneumonia is interesting.   The results of bacteriological investigation of this disease at the City Hospital have shown that it is invariably due to the micrococcus lanceolatus.   The first case reported here throws a great deal of light on those

cases of pneumonia which have been considered to be due to the capsule bacillus. In these cases the growth of the capsule bacillus in cultures is so profuse that it entirely obscures the growth of the diplococcus. Examination of sections of the lung in this case, which were stained both with the Gram Weigert stain and with strong solutions of methylene blue, showed that the bacilli were decolorized by the Gram stain, and the diplococci were present in large numbers in the alveoli, and in the pleural exudation. With the methylene blue stain the bacilli were found in large numbers, chiefly in the bronchi.

In Case IV., in which pure cultures of the bacilli were found in the middle ear, there was no extension into the mastoid cells, or into the cranial cavity. Reports of cases of otitis media due to the capsule bacillus, while not uncommon abroad, especially in Germany, are very unusual in this country. In Case III. the capsule bacillus was found, together with the diphtheria bacillus, and it is a question whether the capsule bacillus was responsible for the inflammation, as we have observed several cases of acute otitis media due to the diphtheria bacillus alone.

SPECIAL NOTICE.

The Journal will be published *immediately* after the meetings of the Society, and will contain authors' abstracts of the papers presented, when these papers are not given in full.

By general consent of the Heads of Departments it will contain full abstracts of experimental work carried on in the following institutions: the Medical School of Harvard University, the Experiment Laboratories of the Massachusetts General and the Boston City Hospitals, the Physiological and Biological Departments of the Massachusetts Institute of Technology, Clark University, and the Anatomical Laboratory of Brown University.

Papers and abstracts of papers upon subjects connected with the Medical Sciences will be welcomed from persons not members of the Society, and if approved by the Council will be presented at the meetings, and will be given a place in the Journal.

When desired, the insertion of papers, if in abstract, will be accompanied by a note indicating the place where they may be found in full. Fifty reprints will be furnished free to authors if the desire for them be expressed on the manuscript.

Subscribers to the Journal are invited to attend the meetings of the Society; the next will be held on April 19, at the Harvard Medical School, at 8 P.M.

All communications should be addressed to the Editor,

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CONTENTS.

JOURNAL

At the meeting of May 24, 1898, the following communications were made :

A COMPARATIVE STUDY OF BOVINE TUBERCLE BACILLI AND OF HUMAN BACILLI FROM SPUTUM.

THEOBALD SMITH, M.D.

The following conclusions are based on the study of cultures of tubercle bacilli from 7 cases of phthisis (6 from different towns of the State of Massachusetts, 1 from New Hampshire) and from 6 cases of tuberculosis in cattle (5 from different herds in Massachusetts, 1 from Virginia). Besides these, cultures from a coati (presumably infected with human sputum), from a pig, a horse, and a cat were included in the comparative study.   This consisted in the microscopic examination of parallel cultures at various ages, in a study of the inoculation disease in guinea-pigs, rabbits, gray mice, pigeons, and cattle.   All bacilli were isolated through guinea-pigs and cultivated on dog's serum.

1. The sputum cultures, with one exception,[1] resembled one another closely in morphological, biological, and pathogenic characters.   The same is true of the bovine cultures. The differences between the two groups is sufficiently well-

[1] Grew very feebly, so that comparative studies were not satisfactory.

marked to justify the establishment of two varieties. The coati culture resembled the human, the cat and the swine culture the bovine, variety. The horse culture stood between the two in pathogenic power.

2. The differences in the morphological characters of the bovine and the sputum variety are not sufficiently constant to warrant their use in diagnosis. The bovine bacilli are uniformly straight and short; the sputum bacilli are usually longer, but they may be short at the outset and grow longer under artificial cultivation. Form and capacity for staining are more subject to change under the influence of culture media among sputum than among bovine bacilli.

3. The sputum bacilli grow more vigorously on dog's serum from the start (one exception).

4. In guinea-pigs the inoculation disease due to bovine bacilli is more rapidly fatal, the lesions more extensive, and the bacilli far more abundant than in guinea-pigs inoculated with equal doses of sputum bacilli.

5. In rabbits weighing from 1300 to 2200 grams, the intravenous injection of 0.5 cc. of a well-clouded suspension of bovine bacilli is fatal in 17 to 21 days. The lesions are extensive, necrosis of the tubercles is well under way, and the bacilli are very numerous, at the time of death. Rabbits inoculated with equal doses of sputum bacilli regain and even surpass their initial weight after 1½ to 2 months (one explainable exception). Chloroformed after 2 to 3½ months, these animals show a restricted number of foci, in which necrosis is slight or absent and tubercle bacilli, as a rule, scarce.

6. Gray mice are, with rare exceptions, refractory to both bovine and human bacilli.

7. Pigeons are likewise insusceptible to both varieties.

8. In cattle the intrathoracic injection of bovine bacilli produced extensive disease, with death in 2 out of 5 cases. Sputum bacilli produced in 5 cases only a localized disease where the bacilli were deposited.

9. Differences in the histological structure of the tubercles produced in rabbits and guinea-pigs by the different varieties of tubercle bacilli were limited to the presence or absence of

giant cells and of peripheral zones of lymphoid cells. In all
situations the multiplication of tubercle bacilli was associated
with the appearance of foci of so-called epithelioid cells,
more rarely giant cells only (as in the liver of some rabbits).
In cattle the reaction due to the presence of sputum bacilli
tended in general towards the formation of granulation
tissue.

10. The differences between bovine and sputum bacilli will
probably enable us to determine more definitely the agency
of cow's milk in the tuberculosis of infancy and childhood.

11. Sputum bacilli are presumably not capable of infect-
ing cattle spontaneously.

ACUTE INTERSTITIAL NEPHRITIS.

W. T. COUNCILMAN, M.D.

An acute inflammation of the kidneys characterized by
cellular and fluid exudation in the interstitial tissue accom-
panied by, but not dependent on, degeneration of the epithe-
lium.   The exudation is not purulent in character, and the
lesions may be both diffuse and focal.   This condition has
been described by a number of authors, and has been found
chiefly in scarlet fever.   In these descriptions the character
and origin of the cells have received but little attention.   The
cells have been generally described as lymphoid cells, and
the condition of acute interstitial nephritis was described by
Wagner as lymphomatous nephritis, and regarded by him as
one of the four forms of acute Bright's disease.

Various degrees of the process may be met with.   In the
most marked cases the kidneys are greatly enlarged; in one
case in a child 2 years old the combined weight of both
kidneys was 450 gms.   The surface of the kidney is generally
pale and mottled.   On section it is moist, and a milky fluid
can be easily pressed out from the tissues.   In the less
marked cases there is little or no alteration in the kidney to
the naked eye examination.

On microscopic examination the chief lesion in the kidney
consists in an infiltration of the interstitial tissue with cells.
In the most marked cases there is a general infiltration

throughout the entire kidney, but which is more marked in certain areas. In the less marked cases the cell accumulations are distinctly focal. In all of the cases there is degeneration of the epithelium, but the foci in the interstitial tissue are evidently not dependent upon this, and the degeneration is no more marked in these foci than elsewhere. The cells found in the tissue vary somewhat in size, and may be from 2 to 4 times the diameter of a red blood corpuscle. The protoplasm is dense and stains deeply with strongly alkaline methylene blue. It also stains more vividly with other nuclear stains than does the protoplasm of the epithelial cells. The nuclei of these cells are characteristic. They are usually eccentric, the general body of the nucleus stains deeply, and there is a deeply stained rim with irregular projections towards the interior of the nucleus. In the interior of the nucleus there are round or irregular brightly stained masses of chromatin, which are often connected by a network with the projections on the rim. Some of the cells have 1, others 2 or 3, nuclei.

These cells were first described by Unna under the name " plasma cells." He at first regarded them as of the same character as the cells described by Waldyer under this name. Unna found these cells in tuberculosis and afterwards in a number of other affections of the skin. They were afterwards studied by various observers, especially by Marschalko and Justi. They have been found in a great number of pathological processes, and in the spleen, bone marrow, and lymphatic glands of normal individuals. Unna supposed they were formed from the connective tissue corpuscles, but later observers have generally ascribed their formation to the small lymphoid cells.

In cases in which I have found these cells in the interstitial tissue they were also found in the blood-vessels, and I have seen them in the act of emigration. They were also found in the blood-vessels in considerable numbers without any involvement of the interstitial tissue. In all of the cases in which these cells were found in the kidney they were found in great numbers in the spleen and bone marrow. In the

spleen they are apparently formed from the lymphoid cells of the Malpighian bodies, and these are sometimes almost entirely converted into masses of plasma cells. Groups of plasma cells are also found in the pulp and in the blood-vessels. Very active proliferation by means of mitotic nuclear division is found in the cells, both in the spleen and in the kidney.

In the examinations of the kidneys of the autopsies made in the last 2½ years 42 cases of acute infectious diseases have been found in which acute interstitial nephritis was present. All the cases in which interstitial infiltration with plasma cells was found, no matter of what extent, are included in these. Cases in which lymphoid cells were found around the large inter-lobular veins are not included. The majority of cases of acute interstitial nephritis come from the acute infectious diseases of children, which form a large part of the autopsy material of the Boston City Hospital. In 103 cases of pure diphtheria, interstitial nephritis was found in 24; in 20 cases of pure scarlet fever it was found in 5; in 23 cases of mixed infection of diphtheria with scarlet fever it was found in 5; and in 2 out of 5 cases of diphtheria and measles. The other diseases in which the lesion was found were measles and whooping cough, 1; empyæma with sub-sequent diphtheria, 1; lobar pneumonia and pericarditis, 1; epidemic cerebro-spinal meningitis, 1; lobar pneumonia, 1; acute glomerulo-nephritis, 1; acute endocarditis following abortion, 1.

The results of bacteriological investigations both by microscopic examination of sections stained for bacteria and by cultures of the organs made at the autopsies have shown that the focal interstitial lesions are not due to bacteria. The result of the cultures of the kidneys in the 42 cases of interstitial nephritis were as follows: In 24 cases of pure diphtheria the kidney was sterile in 6; in 11 the colon bacillus was found; in 1 the staphylococcus aureus; in 5 the streptococcus pyogenes; in 8 the diphtheria bacillus; and in 1 the bacillus fœtidus. In the 5 cases of pure scarlet fever the colon bacillus was found in 2, the therptococcus in 3, and

the staphylococcus in 1. In the 8 cases of mixed infection of diphtheria with scarlet fever or measles 2 were sterile; in 3 the streptococcus and in 3 the colon bacillus was found. In the other 6 cases the colon bacillus was found in 3; the staphylococcus aureus in 2; the streptococcus pyogenes in 4; the pneumococcus in 1; and 1 case was sterile. The result of the bacteriological examination of the kidneys in the same diseases, but in which interstitial lesions of the kidneys were not present, have shown the same results. The kidneys were either sterile or the same organisms were present in about the same proportion.

These focal interstitial lesions can only be accounted for by the local presence in the kidney of substances which exert a positive chemotaxis for these cells, or by some mechanical condition of the circulation in the kidney which would lead to their accumulation in the blood-vessels. The fact that they are so frequently found both in interstitial lesions in the boundary zone of the pyramids or in the blood-vessels of this part without interstitial lesions would tend to show that the slow circulation in the veins might account for their presence. The epithelial degeneration seen in these cases consists in a varying degree of cloudy swelling, fatty and hyaline degeneration. No evidence of degeneration is seen in the plasma cells, with the exception that in a few places vacuoles may be found in the cells, which are sometimes filled with a hyaline substance which often stains deeply with methylene blue. Investigations are now going on to determine the presence and frequency of these cells in the perpherial circulation and the part they may possibly play in the general pathology of diphtheria.

A CASE OF ISOLATED URTICARIA OF THE TONGUE ASSOCIATED WITH ACHLORHYDRIA:

J. L. GOODALE, M.D., and H. F. HEWES, M.D.

The following case of isolated urticaria of the tongue is apparently unique:

When first seen the patient, a man 38 years of age, presented on the dorsum of the tongue areas of rounded outline in which the filiform and fungiform papillæ were moderately and symmetrically swollen, brightly reddened, passing without other line of demarcation to the adjacent normal epithelium. These areas were marked by sensitiveness to mechanical, thermic, and chemical irritants. Symptoms of paresthesia, change in special sensation, and spontaneous pain were absent. According to the patient's account the upper surface of the tongue had for the past 4 years been affected by similar red sensitive areas. During the past 2 years he had scarcely ever been free from them.

For a period of several months the patient was under my observation, using various sorts of local treatment without benefit. During this time the evolution and course of the red areas was repeatedly observed. Within a few hours a given patch would arise evenly and simultaneously over its extent, subsiding in a day or two in a like manner. Peripheral extension and confluence of neighboring areas at times resulted in involving the greater portion of the dorsum. Excessive epithelial exfoliation was not noted. The rest of the mouth was generally normal, although occasionally a transitory reddening of portions of the mucous membrane of the cheeks and lips was observed. The skin was at no time involved.

The histology of the condition was studied from a speci-·men excised from the dorsum of the tongue, including part of a reddened area and the adjacent normal tissue. The changes in the first place consist in an increased cellular proliferation of the rete mucosa, shown by the unusual number of mitoses in its inferior portion. The corium exhibits small areas of edema between the elastic bundles, together with a heightened proliferation of the endothelial cells of the capillaries. The endothelial cells exhibit marked swelling of their cytoplasm. In the neighborhood there is distinct infiltration of polymorphonuclear neutrophiles and of cells having the character of lymphoid cells, together with a small number of mastzellen. No plasma cells or eosinophiles are encountered.

From the clinical and pathological appearances the diagnosis was made of urticaria of the lingual mucous membrane.

The patient was subject to more or less constant symptoms of digestive disturbance, and it seemed wise to investigate this aspect of the case.

They followed ingestion of food of any kind, if taken in sufficient amount to satisfy the patient's appetite. Small amounts of milk, or bread, or meat could be taken without symptoms.

The patient had been accustomed to excessive indulgence in alcohol and tobacco. The past history was otherwise negative.

The examination of the condition of the gastric secretions revealed a total absence in the secretion of hydrochloric acid.

In the gastric contents expressed upon ten occasions, at periods of from ¾ of an hour to 2½ hours after the ingestion of an Ewald test breakfast, free hydrochloric acid, and combined hydrochloric acid, were absent on all occasions.

The Ewald-Sjoqrist test for combined HCl was negative.

The reaction of the contents was acid. The total acidity varied from 0.2 to 0.4 g. per mille. This acidity was presumably due to the test meal. The total acidity of an infusion of bread and water, such as was used for a meal, was found to be 0.4 g. per mille.

The functions of the secretion of pepsin and of rennin were still extant, both ferments being present in HCl wash-water.

The function of proteid digestion was absent.

There was diminished motility, the food remaining in the stomach for a longer period than normal.

The evidence of the analysis of the gastric contents then pointed to the existence of a condition of achlorhydria.

This is found in atrophy of the glandular structure of the gastric mucous membrane.

It is also found in conditions of disturbance of the innervation of the secreting cells where no pathological changes of the nature of atrophy are present.

The achlorhydria in both states may or not be associated with a loss of the production of pepsinogen and rennet

zymogen.   (It is doubtful whether these substances are en-
tirely absent in any condition.)   It is impossible to deter-
mine definitely the underlying pathological condition in the
case in hand.   The history of the case argues for a chronic
gastritis, with progressive atrophy of the secreting structures
of the gastric mucous membrane.

After the commonly stated hypothesis that urticaria may
be secondary to a condition of intestinal sepsis, it seemed
possible that the urticaria in this case might be the resultant
of intestinal sepsis consequent upon the absence of the nat-
ural antiseptic of the food in the upper intestinal tract, the
free HCl of the stomach.

Upon the assumption of the existence of intestinal sepsis
as a possible cause of the urticaria, an antiseptic for action
in the intestine was administered.   As it was impossible to
utilize the natural antiseptic, free HCl, in this case, an arti-
ficial antiseptic — salol — was used.   During the first week of
administration the conditions of the tongue began to im-
prove.   In the course of the second week the urticaria dis-
appeared entirely from the tongue, and did not again return
during the period of administration of the salol.   Further
experimentation with other antiseptics is in progress.

OBSERVATIONS UPON THE ELASTIC TISSUE OF CERTAIN
HUMAN ARTERIES.

GEORGE BURGESS MAGRATH, A.B.

I. *Introduction.*

The observations which I wish at this time to present to
the society were made preliminary to a study of the patho-
logical anatomy of arteries, for the purpose of obtaining
additional evidence as to the structure and arrangement of
the elastic tissue of the vessels under normal conditions.

The most recent comprehensive account of the elastic
tissue of normal human arteries seems to be that given by
Grünstein in a paper " On the Structure of the Larger
Human Arteries," published in Schulze's Archiv in 1896.
This observer investigated very carefully the aorta, and the

subclavian, common carotid, and common iliac arteries, at various periods of life, demonstrating the elastic tissue elements by means of orcein. Of other arteries he makes no mention further than to state that all arteries of middle size have the same type of structure.

II. *Method.*

In the present investigation the method was adopted of examining arteries varying widely in size and in anatomical distribution, and at different periods of life. The vessels selected for study comprise:

The aorta and the following arteries:

Basilar.	Innominate.
Brachial.	Internal Mammary.
Carotid — common, external, and internal.	Mesenteric — superior and inferior.
Cerebral.	Radial.
Celiac axis.	Renal.
Coronary.	Splenic.
Femoral.	Subclavian, and
Hepatic.	Vertebral.
Iliac — common, external, and internal.	

These arteries, grouped according to their size, present the classified arrangement shown in the table.

The ages represented are: Eight months in utero. Four months, $1\frac{1}{2}$, 2, 3, 4, 5, 6, 9, 19, 20, 26, and 46 years. No especial account has been taken of *sex*. The material was derived from the post-mortem examinations of fourteen individuals, in whom there was to be found no evidence of any abnormal condition of the arteries. Specimens of all the arteries named were not collected in every case, but from three to a dozen preparations of each vessel have been available for study.

In collecting tissues care was exercised to take the specimen for preservation in each instance as nearly as possible from the same point in the course of the artery.

Tissues were hardened in 70 per cent. alcohol, and embedded in celloidin.   Sections were cut in transverse, longitudinal, and occasionally also in an oblique plane.   In the case of the aorta sections parallel with the surface were made from small rectangular pieces cut from the wall of the vessel, flattened out in the fresh state upon pieces of glass of the same size, and embedded in this position.

Sections were stained with Mallory's Phosphotungstic Acid Hæmatoxylin, which is made by dissolving 0.1 part hæmatoxylin crystals in 100 parts 1 per cent. phosphotungstic acid.   Sections stained 18 to 24 hours, washed in water, dehydrated in 95 per cent. alcohol, and cleared and mounted in the usual manner, show: Nuclei, stained purple; smooth muscle fibre, pink; connective tissue, red or grayish red; endothelium uncolored, or pale brown; and elastic tissue, deep blue.

This method of staining has the marked advantage over other differential stains for elastic tissue — for example, orcein, and Manchot's fuchsin method — of very great simplicity, no decolorizing or special method of mounting being required.   The results yielded by it seem equal to, if not better than, those obtained by the best of the other methods now in use.

III. *Results.*

The elastic tissue of the aorta is usually and correctly described as consisting of a more or less distinctly marked inner elastic plate, numerous concentric lamellæ of elastic tissue placed at about equal distances from each other throughout the middle or muscular coat, elastic fibres running in various directions between these lamellæ, and a few irregularly disposed fibres in the outer coat.   Seen in cross-section the lamellæ appear as continuous, wavy, more or less concentric lines, at times interlacing, and the interlamellar fibres as fine, thread-like processes.   Seen in longitudinal-section the lamellæ appear as straight, parallel, very much broken lines, with processes running in various directions.   Serial sections cut parallel with the surface greatly facilitate an understanding of the character of these

lamellæ and of the inter-lamellar fibres. The former are seen to consist, in the adult, of homogeneous bands of varying thickness, pierced with round or oval openings, continuous laterally, extending for a greater or less distance longitudinally, and with numerous branch-like processes, some of which present small openings, the processes of one plate becoming more or less enmeshed with those of adjoining plates. It would appear that the inter-lamellar fibres are derived from the lamellæ as fine prolongations of their processes. In the child, and occasionally under high magnifying power in the adult, these lamellæ may be seen to have a fibrous structure, the direction of the fibres being, in the case of the innermost, — the layer corresponding to the inner elastic plate, — longitudinal, and in that of the other lamellæ circular.

The aorta was examined at various points: at the ascending, the transverse, and the descending arch, and at the level of the cœliac axis. No differences in the character of the elastic tissue at these levels were found other than that in the abdominal aorta there is a fairly definite inner elastic plate, while in the arch it cannot be distinguished.

The elastic tissue of an artery is ordinarily described and figured as consisting of an inner elastic plate, separating the intima from the media; a few thin elastic fibres in the media, seen in cross-section as short, fine, wavy lines, circular in direction, and distributed throughout the muscular coat; an outer elastic plate; and a few scattered fibres of elastic tissue in the adventitia.

It would appear, however, that elastic tissue occurs in the walls of arteries in a variety of ways.

In certain arteries the elastic tissue presents an arrangement not unlike that of the aorta, consisting of a more or less well-marked, fenestrated, inner elastic plate, longitudinal in direction, concentric lamellæ in the media, placed at about equal distances from each other, and in the adventitia a few scattered fibres. Vessels presenting this abundance of elastic tissue in the muscular coat of their walls are the axillary, common carotid, common iliac, internal mammary, and

subclavian. It is apparent that this type of structure obtains in arteries differing widely in size.

A second type of arrangement differs from the preceding in that the concentric lamellæ are limited to the outer half of the media, the inner half presenting irregularly scattered, thin, delicate elastic fibres; and in that outside the media, constituting an outer elastic plate, there are several circular bands of elastic tissue. This form of arrangement is to be seen in the celiac axis, the external and the internal carotids near their origin, and in the common femoral.

The arrangement ordinarily described as characteristic of arteries in general constitutes a third type. Here the elastic tissue occurs in the form of a thick, prominent internal plate, pierced with round or oval openings, longitudinal in direction; in some cases, for example, in the external iliac and the femoral arteries, composed of two layers, the inner of which is longitudinal; a definite external plate composed of an inner circular layer of 3 to 5 bands and an outer layer of longitudinal fibres and fibres having a radial or an irregular direction, the latter two sets forming a dense mesh-work and extending for some distance into the adventitia; and, lastly, thin, delicate circular bands of elastic tissue scattered throughout the media. This is the type of structure present in the brachial, superficial femoral, hepatic, internal iliac, mesenteric, radial, renal, and splenic arteries, — vessels presenting very marked differences in point of size.

A fourth and last type is characterized by having a thin internal elastic plate composed of longitudinal fibres, a few fine circular fibres within the media, and a fine mesh-work of longitudinal and radial fibres outside the media and extending into the adventitià. This mode of occurrence of elastic tissue in minimum amount is seen in the basilar, the cerebral, the coronary, and the vertebral arteries. It is noteworthy that in these vessels the muscular coat is relatively thick. These types of structure in important points are constant for the different periods of life studied.

IV. *Conclusions.*

To summarize briefly the results of these observations:

(1.)   The elastic tissue of the aorta consists of a system of richly-branched bands or plates and an intermediate mesh-work of elastic fibres derived from the processes of these plates.

(2.)   This tissue occurs almost wholly in the middle or muscular coat, very few fibres being present in the outer or connective tissue coat.

(3.)   These structural characteristics are constant in important points for different levels of the aorta.

(4.)   The elastic tissue of the aorta of the child differs from that of the adult in that the lamellæ or plates in the former are placed more closely together, are more fibrous, finer, and thinner than they are in the latter.

(5.)   The elastic tissue of the arterial wall does not present a uniform mode of arrangement throughout the circulatory system, but several distinct types of structure may be recognized:

(*a.*)   A type characterized by abundance of elastic tissue, situated almost wholly in the middle coat.

(*b.*)   A type in which it occurs chiefly in the outer half of the media and to a slight extent in the adventitia.

(*c.*)   A type presenting a relatively small amount of elastic tissue occurring chiefly in an inner and an outer elastic plate.

(*d.*)   A type in which there is a minimum amount of elastic tissue, consisting of a delicate longitudinal fibrous mesh-work upon the inner and the outer boundary of a relatively thick muscular coat.

(6.)   The arteries, of whatever size, presenting the type of structure characterized by a relatively small amount of elastic tissue appear to be those the function of which is to distribute blood to viscera and soft parts, vessels which probably undergo more or less physiological fluctuation in calibre.

A NEW METHOD FOR THE STUDY OF THE ISOLATED MAMMALIAN HEART.

W. T. PORTER.

The following experiment describes a new method for the isolation of the mammalian heart:

May 2, 1898. A cat was bled and the blood defibrinated and filtered through glass wool. Canulas were tied into the right auricular appendix, the pulmonary artery, and the aorta. The canula in the right auricular appendix led to a small reservoir of blood. The pulmonary and aortic canulas were each connected with glass tubes which rose to a short distance above the blood-reservoir and then turned to discharge their contents into the reservoir itself. All the heart vessels except the two arteries mentioned were ligated. The arrangement, therefore, was closely similar to that of the frog's heart in Williams' apparatus. The heart with its several tubes was now placed in a strong glass cylinder immersed in warm water. The top of the cylinder was provided with a stout brass cap perforated by two tubes. One was a T tube the side branch of which led to a large metal cylinder containing oxygen under high pressure, while the other branch was provided with a stopcock opening into the atmosphere air. The second tube led to a pressure-gauge. So soon as the amount of oxygen began to increase, the heart, which had ceased to beat, began to contract with great vigor. Surrounding the heart with oxygen even at the pressure of the atmosphere was distinctly helpful, but the contractions became decidedly stronger and more frequent as the oxygen pressure rose to a pressure of about two kilograms to the square centimetre. The blood coursed from the reservoir into the right side of the heart. Each beat of the right ventricle drove blood in a stream through the tube in the pulmonary artery back into the reservoir. The heart muscle was nourished through the vessels of Thebesius and the coronary veins. A small quantity of blood found its way through foramina Thebesii into the left auricle and ventricle whence it was pumped by the latter out through the aorta

into the reservoir.   The vigorous beating of the heart continued from early in the morning until late in the afternoon, when the experiment was broken off.   The contractions were very vigorous also at room temperature.

Two conclusions may be drawn from this experiment: (1.) An atmosphere of oxygen is of advantage in maintaining the · contractions of the isolated mammalian heart.   (2.)   A heart fed simply through the veins of Thebesius and the coronary veins will maintain strong rhythmic contractions for many hours if supplied with oxygen at high tension.

The first thought suggested by these statements is whether the mammalian heart, like the frog's heart, will beat when fed on serum alone, provided that a sufficient supply of oxygen is furnished.   The experiment was accordingly repeated on other hearts, but the blood was replaced by serum obtained by centrifugalizing defibrinated blood.   As was expected, the absence of corpuscles made no apparent difference to the heart.   Powerful rhythmic contractions were obtained with the serum alone, so soon as the oxygen tension rose to about two kilograms per square centimetre.[1]

Hence, the mammalian heart surrounded by oxygen at high tension and fed through the vessels of Thebesius and the coronary veins with blood-serum alone will maintain strong rhythmical contractions for many hours.

[1] The paper from which this abstract is made will appear in Volume I. of the American Journal of Physiology.

SPECIAL NOTICE.

The Journal will be published *immediately* after the meetings of the Society, and will contain authors' abstracts of the papers presented, when these papers are not given in full.

By general consent of the Heads of Departments it will contain full abstracts of experimental work carried on in the following institutions: the Medical School of Harvard University, the Experiment Laboratories of the Massachusetts General and the Boston City Hospitals, the Physiological and Biological Departments of the Massachusetts Institute of Technology, Clark University, and the Anatomical Laboratory of Brown University.

Papers and abstracts of papers upon subjects connected with the Medical Sciences will be welcomed from persons not members of the Society, and if approved by the Council will be presented at the meetings, and will be given a place in the Journal.

When desired, the insertion of papers, if in abstract, will be accompanied by a note indicating the place where they may be found in full. Fifty reprints will be furnished free to authors if the desire for them be expressed on the manuscript.

Subscribers to the Journal are invited to attend the meetings of the Society the next will be held on June 7 and June 21, at the Harvard Medical School, at 8 P.M.

All communications should be addressed to the Editor,

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CONTENTS.

At the meeting of June 7, 1898, the following communications were made:

ON THE MORPHOLOGY OF THE DIGESTIVE TRACT OF THE CAT.

FRANKLIN DEXTER, M.D.,

Assistant Professor of Anatomy, Harvard University Medical School.

Is there any constant arrangement of the coils of jejunum and ileum, either in the embryo or in the adult cat?

It is quite certain, to my mind, that no such arrangement exists (within the cœlom proper), either in the embryo or in the adult animal.

Much the more effectual manner of studying the relations of the embryonic viscera (in an embryo whose organs have been previously hardened in situ) is to remove them from the body en masse. This may be accomplished without much difficulty in an embryo of only 14. mm.

The reason of the adult position of certain divisions of the alimentary canal can be accounted for, to a large extent, in the development of the liver.

The liver of the cat, both in the embryo and in the adult, is prone to great variation. This especially applies to the variability in proportion between the different lobes.

The liver seems to grow, to augment in volume, in the direction of least resistance.

If a lobe is late in developing, an adjoining one will supplement it, and will take upon itself, not only its form, but also its relations.

Certain lobes bear quite a different proportion to each other, in the embryo and in the adult. The entire inferior surface of the liver of an embryo 15 mm. presents one deep fossa, whose walls are deeply grooved by the stomach and by the duodenum. As the embryo increases in size the lobes gradually separate from each other so that the fossa disappears, and the shape of the liver is thus changed. During the period when the fossa is present the greater part of the jejunum, colon, and all of the ileum lie in the cavity of the umbilical cord. After their entrance into the cœlom they lie in contact with the inferior surface of the liver, and consequently their growth would tend to separate the liver lobes. The body growth of the embryo allows this to be possible.

The development of the caudate lobe plays an important part in the limitation of the transverse and in the formation of the ascending colon.

The oblique position of the stomach and the obliquity of the lower end of the œsophagus, as seen in the adult cat, seem to be chiefly due to the peculiar relation that exists between them and the Spigelian lobe, during its development.

THE HISTOLOGY OF HYPERKERATOSIS LINGUALIS.

J. L. GOODALE, M.D.

(*From the Laboratory of the Massachusetts General Hospital.*)

Although something over twenty cases of this affection have been reported; no account of its histology has, to my knowledge, yet appeared.

Two instances have come under my observation, both patients allowing me to excise specimens of tissue for microscopical examination.

The clinical appearances in both cases were essentially identical. In each there was present on the dorsum of the

tongue a conspicuous triangular area, extending from the centre backward to the region of the circumvallate papillæ, the apex directed forward, the area exhibiting a blackish mass of compactly matted hair-like structures lying flat on the dorsum.   The hairs on being lifted with the probe were seen to have a length of one-half inch to an inch.   On spreading apart the mass, there was seen in the posterior portion of the affected area a plateau-like elevation of the dorsum of the tongue, like a broad flat wart, raised about three or four millimeters above the surrounding level, with a rough surface, firm and unyielding to the touch.

Elsewhere on the dorsum the filiform papillæ were unusually long, being from one to two millimeters in length. Their color was whitish, conspicuously contrasting with the whitish growth.

Three specimens of tissue were excised from each case, showing, except in minor details, similar appearances.

The closely matted condition of the long filaments over the elevated area above referred to made their removal necessary before a specimen of the underlying tissue could be excised.   The filaments came away readily in coherent masses, on gentle curetting.   They were then floated in water, arranged in as nearly a natural and mutually parallel manner as possible, subsequently dehydrated and imbedded in paraffin.   After this clearing away had been accomplished, a specimen from the elevated area was excised and fixed in Zenker's fluid.

The specimens of tissue from the anterior portion of the filament-bearing area were excised with the processes still adhering, which could be done with only moderate difficulty, as these were neither so long nor so closely packed as on the surface of the elevated areas.

The description of the histological appearances is facilitated by proceeding from below upwards.

I.   The specimen from the elevated area in each case shows a normal condition of the muscular and submucous tissue.

The corium is, as a whole, increased to from two to three

times its natural thickness, this increase being particularly due to a lengthening of the papillæ. As the papillæ exhibit no corresponding lateral enlargement, they present the appearance of slender cones, mostly pointed, a few only being rounded. This lengthening is due to an increase in the number of the component tissue cells of the corium, which show no individual abnormality. In the upper portions of the papillæ a moderately pronounced cellular infiltration is apparent, evenly distributed immediately below the inferior margin of the rete mucosa, not penetrating the latter, showing no tendency to aggregation into groups, gradually diminishing inferiorly, and ceasing at about the upper third of the corium.

The cells composing this infiltration are almost wholly small, round mononuclear cells having the character of small lymphocytes. A few plasma cells and polynuclear, fine-granular neutrophiles are found here and there, but no eosinophiles are met with.

Corresponding to the space between the conical papillæ of the corium, the interpapillary processes of the *rete mucosa* are seen to extend downward as conical prolongations with generally pointed tips.

The cells forming the basement layer of the *rete mucosa* are essentially normal in appearance, being columnar in outline, with a large vesicular nucleus.

In the prickle cells immediately above the basement layer, alterations are observable which become progressively more marked with each succeeding cell layer. The first changes noted consist in the appearance of irregular vacuoles in the protoplasm of the cells, associated with a distortion and shrinking of the nucleus. As shown best by picric acid, these vacuoles are actual deficiencies in the protoplasm, owing to a reticulation of the latter, appearing as a distinct network with delicate strands and meshes of varying size. The nucleus at the same time is shrunken and distorted in outline, while its chromatin is collected in a few irregular, deeply staining fragments.

As one proceeds upward from the lower layers of prickle

cells, the changes just described become in the superpapillary region rapidly more pronounced, while in the interpapillary regions they are slowly and irregularly shown, many cells in the latter situation being but slightly altered from the normal.   At a point ranging from four to ten cell-layers above the basement layer, the nuclei of the cells begin to exhibit fragmentation, with freeing of their chromatin as irregular, deeply staining masses of varying size, while the protoplasm simultaneously exhibits larger vacuoles, from a disappearance of a certain number of the reticular strands. With these changes is associated the appearance of rounded granules of varying size in the vacuoles and along the cell walls, having the staining properties of the original protoplasm of the cell.   The cell walls are well defined and distinctly thicker than normal, while the cells themselves appear more compactly joined.

To recapitulate in brief, the cells in this region exhibit a thickened wall, staining deeply with picric acid, eosin, and orcein; the originally homogeneous protoplasm shows a collection into threads and granules, staining, though less deeply than the wall, with picric acid, eosin, and acid orcein; the nucleus shows a fragmentation, its chromatin particles staining with methylene blue, acid fuchsin, and hæmatoxylin.   With Unna's stain for keratohyaline, the chromatin fragments stain with moderate intensity.

In the squamous layer of epithelium, the cells occupying the superpapillary region show generally no indication of a nucleus, but are filled with granules and masses of basophilic and acidophilic reaction, the arrangement of which corresponds to the shape of the cell, so that they appear as more or less parallel rows and lines.   The superpapillary epithelium is, on its free surface, prolonged upward to form slender acuminate processes, composed of squamous cells containing the characteristic granules just described, which now are arranged in a linear manner.   From the summit of these processes long, slender filaments are given off.   These are the microscopically visible " hairs, " and will be described below.

The horny layer of epithelium extends from the inter-

papillary region upward along the margins of the acuminate processes into the filaments. Sections stained with acid fuchsin and picric acid show that the characteristic keratin stain first appears in the interpapillary region of the epithelium at a distance of ten to fifteen cell layers below the surface as an irregularly outlined inverted cone, of which the base forms the interpapillary epithelial surface. From the base of the cone the keratin stain runs upward along the margins of the acuminate processes as a sharply defined broad band.

Examination of the interpapillary keratin cone shows that it first appears in the cells as a light-red wash evenly laid over both protoplasm and cell wall. Its appearance and the intensity of its development bear no relation to the basophilic granules previously described, for it is at times found in cells whose nuclei, although flattened or shrunken, show no dispersion of their chromatin, while other cells in the immediate neighborhood, with free-lying fragments of chromatin, do not exhibit the keratin reaction. Along the margins of the acuminate processes the keratin stain is evenly laid over both the walls of the flattened cells and their interior lines of granules, which stain more deeply red and are thus recognizable, where the keratin overlay is not too intense. With Unna's stain for keratohyaline, — of hematoxylin followed by potassium permanganate, — the keratin band does not stain, although, as previously stated, the basophilic granules are stained with moderate intensity. With acid orcein and polychrome methylene blue, the keratin layer exhibits a light-blue color in which the deeper blue granules are conspicuous.

A filament or " hair " has the appearance in longitudinal section of a long, slender feather with a central shaft and lateral webs. The shaft is composed of long, flattened, closely appressed cells, exhibiting the reaction for keratin, and containing in their interior, lines and series of basophilic granules similar to those found more deeply in the epithelium. From this central shaft the lateral branches forming the webs are given off in an imbricated manner, radiating outward and downward.

An examination of an *unstained* longitudinal section of a filament under a low power shows that the lateral branches given off from the first two or three millimeters of the proximal portion of the shaft are without color, while from this point towards the distal end, and progressively increasing in intensity, a brownish coloration of the lateral branches is visible. This coloration is seen on an examination of unstained specimens under high power to be due to the presence of round, highly refractile, yellowish-brown granules, ranging in size from those scarcely perceptible under the oil immersion to others equalling a red blood corpuscle. The smallest granules are found in the proximal portion of the shaft, where they are situated in the interior of the fibres composing the web. Towards the distal end the granules become progressively larger, and many are found lying free between contiguous fibres. These granules do not stain with eosin, picric acid, or acid orcein. With polychrome methylene blue they take on a light-green color, with acid fuchsin a reddish-orange, but do not seem actually to stain.

The fibres of the web are long, slender, homogeneous structures staining with eosin and picric acid.

On staining a longitudinal section of a filament for bacteria, there is seen to be distributed between the lateral fibres of the web a characteristic bacillus in great abundance. The first growth of this organism is found where the refractile granules begin; namely, at a point two or three millimeters from the proximal end of the filament, increasing progressively in abundance towards the distal extremity. The bacillus is about the width of the hay bacillus, six to eight times longer than broad, straight, with slightly rounded ends, and generally joined with others end to end, forming chains of four to ten. They stain evenly throughout their length, and stain by Gram. They outnumber greatly all other forms of bacteria, which are chiefly cocci, and found along the outer margin of the web.

THE TUBERCULIN TEST IN MAN.

CHAS. NORTON BARNEY, M.D.,

Acting Assistant Surgeon, U.S. Navy.

In view of the fact that we have had in Boston very little discussion on the use of tuberculin as a means of diagnosis in man, I should like to present a synopsis of results in thirty-eight miscellaneous cases, and to speak briefly of certain objections which have been made to the test, and especially of the means by which sources of error in its application may be excluded.

Report of Injections.

Half of the injections I report were made in 1896, on the service of Dr. Wm. L. Richardson, at the Massachusetts General Hospital, and half in cases which I have attended this year as District Physician of the Boston Dispensary.

In each of the hospital cases the injection was given at eight in the evening, and observations of temperature were made every four hours for at least a day before and for two days after the injection. In the dispensary cases the injections were given at noon, and observations of temperature were taken twice a day. In all cases the injections were made deep into the muscles of the thigh with an ordinary hypodermic syringe, after sterilization of both syringe and skin. The test solution consisted in every case of a freshly made one per cent. solution in water of Koch's original tuberculin. The dose was fifteen minims of this solution, corresponding to ten milligrams of tuberculin. There were three cases which gave atypical reaction of this dose, and in these the test was repeated with fifteen milligrams. Only those reactions were accepted as distinct in which a febrile condition, with malaise, headache, backache, and with temperature at a maximum of at least 102°, came on within twenty-four hours after the injection, and persisted for at least twelve hours. In cases in which the temperature had been above normal before the injection, those reactions only were accepted in which the temperature reached a higher point than the maximum recorded on a four-hourly chart kept for two or

three days before the injection, and in which, also, the rise of temperature came at an hour when in previous days the temperature had been at its minimum.

The cases injected were as follows: 14 cases known to be tuberculous, four cases probably tuberculous, and 20 cases without any evidence of tuberculosis whatever — 38 cases in all.

Of the 14 cases known to be tuberculous the diagnosis was confirmed by microscopic examination in 10; namely, six cases of early phthisis, and one each of tuberculosis of the peritoneum, kidney, glands, and knee-joint. The remaining tuberculous cases comprised one case of phthisis, with cough, loss of weight, sweats, and signs of infiltration at one apex; another case of phthisis, with debility and hemoptysis; one case of acute pleurisy, with cough, loss of twenty pounds' weight in five months, and tuberculosis in his immediate household; one case of anemia, with pyelo-cystitis, loss of weight, sweats, cough, and unusually well-marked family history of phthisis.

The four cases thought to be probably tuberculous, but not known to be so, were two of anemia and two of chronic diarrhea.

The 20 cases in which there could not be obtained the slightest evidence of tuberculosis were as follows: Three each of bronchitis, debility, and myalgia, two of chronic diarrhea, and one each of subacute lymphatic leukemia, chronic gastric catarrh, gastric hyperacidity, pernicious anemia, simple chronic peritonitis, tertiary syphilis, subacute articular rheumatism, neurasthenia, and incontinence of feces from an old injury to the sphincter ani.

Of the total number, 21 reacted and 17 did not react. Every one of the 14 cases known to be tuberculous gave a distinct reaction. The four in which the existence of tuberculosis had been thought probable, though not proven, reacted. Of the 20 in which there could not be found the slightest evidence of tuberculosis, three reacted. These three cases were one each of subacute lymphatic leukemia, chronic diarrhea, and chronic catarrh of the stomach. There

was no autopsy in any one of these three reacting cases, and consequently no proof that they may not have had tuberculosis somewhere in the body. I was never able to find any evidence of tuberculosis in any case which did not react, though in three cases a larger dose than ten milligrams was necessary for the production of typical reaction. In no instance have I been able to detect any harm resulting from the injection, beyond temporary discomfort. There was not the slightest reason for supposing in any case that the disease was accelerated by tuberculin.

Why Test is not More Generally Used.

The tuberculin test is recognized to be a practically certain means of determining the presence of tuberculosis in cattle, but in man its use has been limited on account of an allegation that it is liable to start into activity any focus of tuberculosis which may be latent in the body. This grave charge, advanced by the great Virchow himself, supported by Baumgarten, Fürbringer, and others, and widely quoted, at once hindered fair trial. But in spite of prejudice, Koch, the originator of tuberculin, with Guttmann, Ehrlich, Nocard, Wasserman, Benz, Jensen, Trudeau, Springthorpe, Whittaker, Penzoldt, Klebs, Shattuck, Mason, and others, investigated the merits of the test. The verdict, as expressed in statements which these men have made from time to time, is, that tuberculin is a perfectly harmless and most reliable means of diagnosis when properly used. But even yet none of the text-books include tuberculin among the diagnostic methods, and the unfavorable opinions of Virchow and other early experimenters are still quoted by those who have not had personal experience with the test.

Experience shows that unfavorable results in the use of tuberculin for diagnosis are due to faults in the application of the test. A year ago Koch himself reported that many thousand tuberculin injections made in cattle had proven the fear groundless that latent tuberculosis would be roused into activity and spread over the body in consequence of reaction. He said, further, that in his own experience with over a

thousand test injections in man there had never been the slightest reason for suspecting anything like a mobilization or dissemination of the bacilli, and that this experience ought to check prejudice and put the diagnostic value of tuberculin in man on the same plane as in the lower animals.

Sources of Error. — Precautions.

The sources of error which must be excluded before one can draw just inferences from the test are four:

First. *The solution injected must be an active one.* It should be freshly made from a reliable preparation.

Second. *The dose must be sufficient.* Susceptibility to the action of tuberculin varies to such an extent, and the strength of different preparations of tuberculin probably varies also, so that there is no one fixed test-dose which will be, in all cases alike, both efficient and safe. Ten milligrams — that is, fifteen minims of a one per cent. solution — is the dose recommended by Koch in his original announcement to the International Medical Congress at Berlin in 1890. This dose has proven to be safe — at least in fairly strong adults — and is usually efficient. The doses used by many investigators are as small as one or two milligrams or even less, but, though safe, these small doses cannot as often be relied upon to produce reaction as the larger doses. A method of dosage which is safe and at the same time reliable is to use ten milligrams as the provisional test-dose, and if the reaction which may follow this is not distinct, to give another injection of fifteen or even twenty milligrams.

Third. The third source of error is the acceptance of *atypical reactions.* With cases injected in out-patient departments one must rely largely on the statement of the patient as to the occurrence of fever, with malaise, headache, and backache, following the injection; but, of course, such statements are less trustworthy than accurate charting of the temperature from four-hourly observations; and furthermore, it occasionally happens that a case may have very little discomfort after the injection, and yet present a four-hourly chart characteristic of reaction. In all cases where possible a four-hourly

chart should be kept for twenty-four hours before the injec-
tion to determine the maximum range of temperature with-
out tuberculin, and then continued for a day or two more
after tuberculin has been injected. In the typical reaction,
at the end of eight or nine hours if the injection has been
given in the evening, and in a shorter time if given in the
morning, the temperature abruptly rises to about 103°, and
a febrile condition, with malaise, headache, and backache,
and sometimes nausea and vomiting, continues for a day, and
gradually passes off at the end of about twenty-nine hours.
Temperatures not higher than 101°, and febrile paroxysms
coming on immediately after or as long as a day after injec-
tion, are not to be considered distinctive. It may, rarely,
happen that even after a second test-injection with a large
dose of tuberculin, a febrile movement may occur which is
not sufficiently typical to be accepted as a tuberculin reac-
tion. In such a case no conclusion whatever should be
drawn from the test, either as to the presence or as to the
absence of tuberculosis.

Even in cases with moderate pyrexia it is possible to use
the tuberculin test, though with less accuracy than in non-
febrile cases. If it is desired to use the test in a febrile case,
four-hourly observations of temperature should be charted
for several days before the injection. The injection should
be given when the temperature is first found to be dropping,
after it has reached the maximum for the day. For example,
if the temperature has reached its maximum — of, say, 103°
— at four in the afternoon, and is found to have dropped to
102° at the eight-o'clock observation, that is the best time to
give the injection, for if reaction follows it will come at about
four in the morning, the hour when the temperature is ordi-
narily at its lowest point.

Fourth. The fourth and greatest source of error in draw-
ing inferences from the tuberculin test is its very delicacy;
for even tubercular lesions, which are giving no symptoms,
cause reaction to the test, and consequently *in any given case
in which reaction is obtained, this may be due to some quiescent
tubercular focus and not to the important lesion.* This is the

reason why statements have been made that syphilis, actinomycosis, and other diseases, react to tuberculin. The presence of an undoubted reaction indicates not that the disease which is giving symptoms is tuberculosis, but only that tuberculosis exists somewhere in the body. Consequently, in order to avoid this source of error, one must *draw conclusions from those cases only in which no reaction whatever occurs.* If in a hundred cases of cervical adenitis, for example, the reaction is present in sixty-five, doubtful in five, and absent in thirty, this must not be taken to mean that the adenitis is tubercular in sixty-five or seventy per cent., but only that it is not tubercular in thirty per cent.

With the simple precautions stated, one can obviate all the four sources of error which occur in the use of tuberculin for diagnosis.

Reactions in Health.

That eighteen per cent. of patients in whom tuberculosis is not supposed to exist react to tuberculin is not an argument of much weight against the accuracy of the test, as it is well known that healed or quiescent tubercular foci are found in an enormous proportion of autopsies. Many have tuberculosis without suspecting its existence, and many get over it without having had any symptoms from it. As the German maxim goes, " *Jederman hat am ende ein bischen Tuberculose.*"

Value of the Test.

The test, then, when used with the precautions already stated, is accurate and harmless. It is simple in its application. It is a most valuable means of diagnosis — all the more valuable in that it is applicable in the earliest cases. In incipient phthisis, and also in glandular, peritoneal, pleural, and bone tuberculosis, the tuberculin test can be applied earlier than the microscope; and in these cases a negative result from the test properly used is more to be relied upon than a negative result from the microscope. The absence of any reaction whatever from large doses of an active preparation of tuberculin is proof of the absence of tuberculosis.

DEMONSTRATION OF EXPERIMENTAL ATAXIA AND ITS RECOVERY.

L. J. J. MUSKENS, M.D.

Some time ago I began a series of experiments with the spinal cord of cats, to study the influence of different operations upon the muscular tonicity. In these experiments, after section of 4–6 posterior roots in the lumbar region or in the lower cervical and upper dorsal region, I observed disturbances in the motility of the leg concerned, which may be called ataxia. The movements of this leg represent all the peculiarities which we see in locomotor ataxia. The movements are abnormal in size and direction; the suddenness of the movements makes them still more awkward. The similarity to the tabetic movements goes even so far that, in some cats which had already largely recovered from their ataxia, I could see an increase of the disturbances when I put a bandage over the eyes.

In the first cat, I cut on March 24 all posterior roots on the right side from the sixth lumbar to the last dorsal. Three phases can be distinguished in the behavior of the animal after the operation. Immediately after the awakening from the narcosis the cat tried to use the leg concerned in the operation, but in a very atactic and awkward manner. With every step the whole surface of the foot, from the calcaneus to the toes, was smacked down on the floor, with a characteristic noise. Soon the cat gave this up and carried the affected leg (as Sherrington describes for his monkeys) as if in a bandage. Four weeks later the cat attempted to use its leg again, in walking, but with extreme awkwardness. The leg was placed either too far inside, so that the left leg staggered against the anesthetic one, or too far outside, so that the back of the cat sank down at every step. As a rule the anesthetic foot was put down on the floor on its dorsal surface. Especially when the animal tried to walk swiftly, it often fell sideways on the floor. Reflexes, not to be seen at all in the first weeks after the operation, could be produced every now and then from the middle toe. Everywhere else

in the affected leg the anesthesia was nearly complete. The muscular tonicity and the knee-jerk were absent as before, and remained so.

Three weeks later the coördination of the movements is markedly improved, and could be proved by the following experiment: If lifted up by its legs, back down, a normal cat left loose at any distance from the floor will reach the floor with the extremities down. The operated cat was now for the first time able to perform this highly coördinated movement from a height of three feet. Only rarely the anesthetic leg is placed on the floor on its dorsal surface, but still with every step a slight noise is heard, as a sign that the nails of the right hind foot touch the floor. The foot was dragged more or less in a curve, not unlike the manner in which recovering hemiplectic persons usually walk. This last peculiarity can still be observed in the gait two months and a half after the operation. In the hamstring muscles of the affected leg, which are slightly atrophied, I found diminished irritability for the faradic current.

How marked the recovery is, I cannot better prove than by another cat, which underwent the same operation the 12th of May. The movements often seen in the anesthetic leg prove that the leg is not paralyzed, although it is dragged in an absolutely helpless manner, mostly in extension. No knee-jerk, no cutaneous reflexes, no muscular tonicity.

We have here, therefore, two cats, with experimental ataxia, in two different phases of recovery. That we are able to provoke disturbances in the locomotion by severing the centripetal nerves of a limb, as has been shown by Cl. Bernard,[1] Mott and Sherrington,[2] Hering,[3] and Bichel,[4] is no doubt a strong argument that also in tabetic patients the ataxia is due to the loss of sensibility, and not to disturbances of mysterious coördinatory centres. Now, it is interesting to find out in our cats whether the sensibility in the first one

[1] Cl. Bernard. Leçons sur la physiologie et la pathologie du système nerveux, 1858, vol. i., p. 247.
[2] Mott and Sherrington. Proc. Roy. Soc., London, vol. 57, p. 48.
[3] H. E. Hering. Neurolog. Centralblatt., 1897, p. 1077.
[4] A. Bichel. Pflügers Archiv., Bd. 67, p. 299.

operated upon has also gradually improved, so that we can make the recovery of the sensibility account for the recovery of the ataxia.   As to the cat recently operated upon, we find that we can plunge the affected leg in water heated to 60° C. and more, without seeing the slightest reaction in the animal; also, there is no reaction if placed in ice-water.   The sound leg is retracted out of any fluid with a temperature below 25° C. and above 54° C.   In the other cat, which now almost walks in a normal way, the legs are retracted, as well from warm as from cold water, but the limits are markedly wider than for a normal cat, and the retraction is seen to occur after a longer interval.   With the faradic current stimulating, we find analogous results; the same with the sense of touch (squeezing the toes).   As to the other senses, for passive movements, feeling of resistance and weight, I am not able to give any indication.   This statement may be looked upon as being quite in accordance with Leyden's conception of the tabetic ataxia.   The authors cited above made their experiments with other animals, viz.: dogs and monkeys.   Cases of so marked recovery as in the cat have, as far as I know of, not been reported.

Every neurologist who has treated his atactic patients with the method of Freubel, that is, with methodical exercises, will have observed how, sometimes after a few weeks, improvement of the ataxia can be seen.   Both instances of recovery of the ataxia we have to explain in this way: For every coördinated voluntary muscular action, centripetal impulses must reach the spinal cord and brain from the articulations and muscles and integuments of the moving part of the body.   This was more or less clearly announced by C. Bell[1] and Magendie,[2] later by Filehne,[3] Enner,[4] and Freubel.[5]   The eye, and probably the semi-circular organs, are of importance for the normal course of the

[1] Charles Bell.   Philosoph. Transactions, May, 1829.
[2] M. Magendie.   Leçons sur les fonctions et les maladies du système nerveux, 1839, t. ii., p. 47.
[3] W. Filehne.   Archiv für physiologie, 1886, p. 432.
[4] S. Enner.   Pflüger's Archiv., Bd. 48, 1891, p. 592.
[5] Freubel.   Neurol. Centralblatt., 1897, p. 688.

voluntary movements.   If now a voluntary movement has
been exercised a great many times, less and less centripetal
impulses are needed to secure the successful result of the in-
tended movement (acrobats).   As well in the tabetic man as
in the cat with several posterior roots cut, the residuary cen-
tripetal paths are found, after a certain time of exercise, to be
quite sufficient for the normal achievement of a number of
voluntary actions.

Whether, in the cat at least, regeneration of the posterior
roots may occur will be found by subsequent microscopical
examination.   In the literature no evidence is given that the
posterior roots are capable of regeneration.

At the meeting of June 21 the following communications
were made:

CHARACTER OF THE EXUDATE FROM EPIDEMIC CEREBRO–
SPINAL MENINGITIS OBTAINED BY LUMBAR PUNCTURE.

BY A. H. WENTWORTH, M.D.
(*From the Sears Pathological Laboratory of the Harvard Medical School.*)

Character of the Cells.

The cells in the spinal fluid from cases of epidemic cere-
bro-spinal meningitis are chiefly polymorpho-nuclear leuco-
cytes — " pus-corpuscles."   In addition there are found a
varying number of small mononuclear cells — " lymphoid
cells " — and large phagocytic endothelial cells.   These
latter cells are very large and have large oval or round nuclei.
In the protoplasm of some of them one finds leucocytes,
blood-corpuscles, and particles of cell detritus.   In the pro-
toplasm of some of the " pus-corpuscles " one usually finds
one or more diplococci.   Sometimes a leucocyte contains
large numbers of them.   In this variety of meningitis the
majority of the organisms are contained within the " pus-cor-
puscles," and are found only in limited numbers outside of
the cells.

Toward the end of the disease in acute cases which ter-
minate in recovery the " pus-corpuscles " show evidences of

degeneration. The nuclei do not stain sharply and many of the cells appear to be disintegrated. This appearance indicates that the acute inflammatory process has subsided, at least for a time, and may have some prognostic value.

In chronic cases there are fewer " pus-corpuscles." The majority of the cells have single round nuclei. Some of them are smaller than " pus-corpuscles," have very little protoplasm, and are evidently " lymphoid cells; " others are about the same size as " pus-corpuscles," with large round nuclei and considerable protoplasm, and are probably " plasma cells." (Both lymphoid and plasma cells are present in large numbers in the meninges in chronic cases.)

Variations in the Turbidity of the Spinal Fluid, and their relation to the Severity of the Symptoms.

The following results are derived from the examination of the spinal fluid from thirty cases of epidemic cerebrospinal meningitis. In many of these, two punctures were made at different times, and in some cases three or four.

Within certain limits there is some relation between the degree of turbidity of the spinal fluid and the severity of the symptoms. The acute cases almost always show a markedly turbid fluid during the early part of the disease, when the symptoms are severe.

In some cases there is an immediate formation of purulent sediment in the bottom of the test-tube, but in the majority the fluid is simply very turbid and after standing contains considerable fibrin and many cells. The cases in which a purulent sediment forms may prove fatal within a few days, but on the other hand the same kind of fluid may be obtained in cases which are only moderately severe at the time when the puncture is made.

Moderately severe cases may show well-marked turbidity at first, and later punctures, made at intervals of several days, may show a diminution in the turbidity of the fluid, and yet the symptoms may be severer than they were at the time of the first puncture. In other cases the diminution in turbidity may correspond to some extent with the improvement in

the patient's condition. If the fluid in acute cases is obtained late in the disease, at a time when the acute symptoms have for the most part subsided, it may be clear, and the microscopic examination may fail to detect evidences of meningitis. At other times the cloudiness may be very slight, and very little fibrin and only a few lymphoid cells and " pus-corpuscles " may be found by microscopic examination; so that beyond certain limits there is no constant relation between the degree of turbidity and the severity of the symptoms.

In the intermittent cases the spinal fluid may be clear during the intervals that the patient is without symptoms and become turbid again during the exacerbations. This is by no means constant, however. The fluid is very likely to show a slight degree of cloudiness in spite of the absence of symptoms.

It is impossible to say how long a slight cloudiness may persist in chronic cases. I have found more or less cloudiness due to cells in a number in which the disease had lasted for several weeks. From my experience thus far, I would attach more importance to the results obtained by lumbar puncture than to any other means of diagnosis in the doubtful chronic cases seen later, in which even slight cerebral or spinal symptoms still persisted.

In mild cases the exudation may disappear from the spinal fluid in a few days. In the questionable cases in which the fluid appears to be perfectly clear it is necessary to make a very thorough examination of the bottom of the test-tube, with a platinum wire, after the fluid has stood for several hours.

Relation of the Number of Organisms to the Severity of the Disease.

There is no constant relation between the severity of the disease and the number of organisms present in the cerebro-spinal fluid. If the cultures are carefully made *at the time* of puncture, and if the blood-serum is good, we may expect to obtain a growth of the diplococcus intra-cellularis in the majority of acute cases, provided the patient has symptoms of active disease. A number of times I have obtained a

growth of the diplococcus after the disease has lasted more than two weeks. In one case which lasted five weeks I obtained growths in every one of five punctures made at intervals of one week. On the other hand, there have been cases in which the spinal fluid was very turbid, and in which a purulent sediment formed, and no colonies were visible on the serum after twenty-four hours, although a moderate number of diplococci were present in the water of condensation and a very few were obtained by scraping the surface of the serum with the wire. In one such case, lumbar puncture was performed three days after the onset of the disease, at a time when the cerebral and spinal symptoms were intense. In this case, in addition to the very slight growth on the serum no organisms were found in the " pus-corpuscles," although the exudation was purulent. It is difficult to give a satisfactory explanation of such occurrences. It seems improbable that the organisms were dead, and therefore did not stain in the cells or grow on the serum, three days after the onset, with persistence of severe acute symptoms.

One rarely obtains a growth of the intracellular diplococcus in chronic cases. In some instances, however, a few diplococci are found in some of the " pus-corpuscles," and at times a limited number of organisms can be obtained by scraping the surface of the serum when there are no visible colonies. In mild cases the organisms are apparently not very numerous, and one would expect to obtain a negative result so far as the cultures are concerned, unless the punctures were made soon after the onset.

Summary.

1.   There is no constant and definite relation between the severity of the symptoms and the degree of turbidity of the spinal fluid.

2.   There is little or no connection between the number of organisms and the number of cells present in the spinal fluid.

3.   In many cases there appears to be but slight connection between the number of organisms found in the spinal fluid and the severity of the disease.

4.   Unless the subsequent examination of the spinal fluid is carefully performed no deductions as to the presence or absence of meningitis are justifiable.

SPHYGMOGRAPH CURVES FROM FIFTEEN THOUSAND SEVEN HUNDRED FEET AND FROM NINETEEN THOUSAND TWO HUNDRED FEET ABOVE SEA LEVEL.

By ROBERT DeC. WARD,
Instructor in Climatology in Harvard University.

During a recent stay of three months at the Southern Station of the Harvard College Observatory, at Arequipa, Peru (lat. 16° 22′ 28″ S.; long. 4 h., 46 m., 12 sec.), the writer twice had occasion to visit the highest meteorological station in the world, situated on the summit of El Misti, a quiescent volcano 19,200 ft. above sea level.   On the first trip the discomfort caused by mountain sickness was so great that it was found impossible to obtain good results with the sphygmograph, although an attempt was made to do so.   During the second expedition, however, on Nov. 10, 1897, the disagreeable symptoms of mountain sickness were much less marked, and fairly good tracings (with the Dudgeon sphygmograph) were obtained, of which the accompanying figures are reproductions.   While these curves possess little real value, on account of the difficulties under which they were secured, they are of some interest from the fact that they are the first from so great altitudes to be reproduced, and from the fact that whatever peculiarities of heart action are shown in them are the result of the altitude pure and simple, as absolutely no physical exercise was taken in making the ascents.

The tracing from 15,700 ft. (about the altitude of the summit of Mont Blanc) was obtained about 8 P.M., Nov. 9, 1897, in the hut at the base of the Misti, in which observers on their way to visit the summit station pass the night.   The observatory at Arequipa (8,050 ft.) had been left at 6.30 A.M., and the journey to the hut was made entirely on mule-back.   Twelve hours before leaving Arequipa the pulse was 91, the tem-

perature 98.6°, and the respiration 20. An hour after arrival at the hut the pulse was 128, the temperature 97.0° and the respiration 30.

The second tracing was obtained on the summit of the Misti, at about 10 A.M., November 10, half an hour after reaching the station. The preceding night had been spent, without serious discomfort from mountain sickness, in the hut, at 15,700 ft., and the ascent from that point to the summit was accomplished in four hours and a half, on mule-back.

At the hut, immediately after waking up in the morning, the pulse was 112, the temperature 96.2°, and the respiration 30. Twenty minutes after reaching the summit the pulse was 120, the temperature 97.2°, and the respiration 32. Two hours after reaching the summit the pulse was 112, temperature 96.8°, and respiration 34. One hour after arriving at Arequipa, on the return, the pulse was 116, temperature 98.2°, and respiration 22, and twelve hours after arrival the figures were 82 for the pulse and 22 for the respiration, the writer's normals at Arequipa being about 82 and 20 respectively.

The writer was obliged to manage the sphygmograph alone, and this was a difficult matter, especially in view of considerable suffering from a severe headache, some nausea, and from the cold. It was impossible to adjust the instrument firmly to the wrist, and therefore the pressure on the pulse during the operation was not quite constant.

For purposes of comparison, a pulse tracing made at sea level shortly before the ascent of the Misti is here reproduced.

APPARATUS FOR ILLUSTRATING THE MOVEMENTS OF THE EYE.

H. P. BOWDITCH.

The apparatus shown this evening is merely a modification of the one exhibited by Dr. Wadsworth at the meeting of this Society on April 19, 1898. The most important modification consists in the addition of two great circles (or rather semicircles) situated, as Dr. Hay described them at the same

FIG. 1. — Sea level.

FIG. 2. — M. B. Hut.   Elevation = 15,700 ft.

FIG. 3. — Summit of El Misti.   Elevation = 19,200 ft.

meeting of the Society, " in the secondary vertical plane and in the plane of sight."   In the primary position of the eye these two great circles coincide respectively with two other great circles fixed in the globe of the eye, viz.: the primary

FIG. 1.
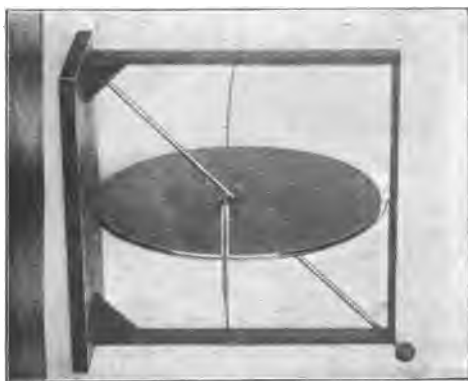
vertical meridian and the retinal horizon.   This position of the eye is illustrated by Fig. 1.

Now when the eye is rotated around a vertical or a horizontal axis, the coincidence of the great circles is not affected, but if the rotation takes place around an *oblique* equatorial axis, the relation between the great circles is changed in such

a way that the primary vertical meridian seems to be inclined
outward with reference to the secondary vertical plane, while
the retinal horizon seems to be rotated inward with reference
to the plane of sight.   This change of relation is illustrated
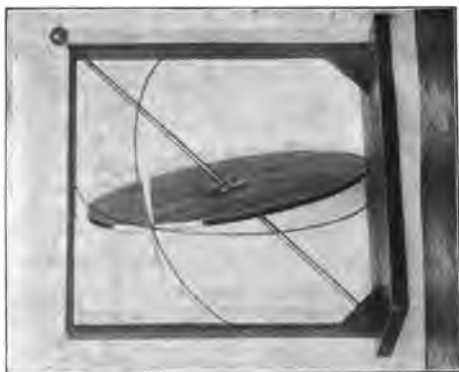
FIG. 2.
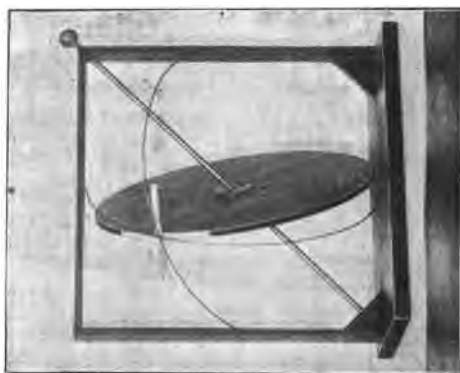
by Fig. 2.   This apparent twisting of the eye in two oppo-
site directions at the same time, which has been demon-
strated by the method of after-images, by many writers on
the subject, cannot, of course, be due to any actual movement
of the eye itself, and Dr. Hay has clearly shown that the
cause of the phenomenon is to be sought in the changed

relations to each other of the two great circles outside of the
eye, viz.: those representing the secondary vertical plane
and the plane of sight. · These planes, which are at right
angles to each other in the primary position of the eye, and
remain at right angles when the eye is rotated around a ver-
tical or a horizontal axis, change their position with reference
to each other when rotation takes place around an *oblique*
axis, the angle between the planes becoming, in this case,
less and less, until, when the eye has rotated through 90°, the
two planes coincide.

By placing a system of vertical and horizontal lines in
front of this model it is easy to show that the two great circles
outside the eye are in all positions projected as vertical and
horizontal lines on a plane at right angles to the primary
position of the axis of vision.

It will be observed that Figs. 1 and 2 are reversed stere-
oscopic views of the model.   They are printed in this way,
because a true stereoscopic effect may be thus readily ob-
tained by crossing the axes of vision in front of the page in
such a way that the image of the left picture falls upon the
right eye and *vice versa*.   It is of course necessary to focus
the eyes for a more distant point than that upon which they
are converged, but this form of dissociation of the focal and
axial adjustments is as a rule more easily acquired than that
in which the eyes are accommodated for a near object while
the axes of vision are parallel, a condition which must be
realized when the use of a stereoscope is dispensed with in
viewing ordinary stereoscopic slides.

HISTOLOGY AND PATHOLOGY OF THE MIDDLE TURBINATED BONE.

FREDERIC C. COBB.

(*From the Laboratory of the Massachusetts General Hospital.*)

To Woakes must be given the credit of first calling atten-
tion to the pathological condition of the middle turbinate, and
suggesting its connection with necrosing ethmoiditis.   Ap-
proached from a clinical standpoint, he finds, first, an

increase in the size of the turbinate, which gradually enlarges until it partially obstructs the nostril. Rhinological examination shows an irregular reddish· budding of the surface, which gradually becomes transformed into a polypoid condition. At the same time the probe introduced into the nares finds rough or bare bone on the outer surface of the middle turbinate. Woakes calls attention to the fact that the ethmoid is a sponge-like bone perforated with canals, lined with a muco-periosteum continuous with the nasal mucous membrane, so that inflammation of its covering may lead to a complete affection of the whole ethmoid bone. He believes that inflammation in the sponge-like cavities of the bone finally causes a pressure outwards, and rupture occurs at the weakest point. A polyp-like bud pushes downward, and gradually increases in size until it appears as the well-known polyp. Here we have two clearly marked theories; first, that infiltration occurs in the mucous membrane, causing or associated with necrosing bone in the interior of the turbinate. Second, that it is a pressure in the sponge-like cavities of the middle turbinate which causes the bony wall to give way and a polyp to form.

In support of these views, Woakes shows two microscopic specimens, selected at random from a large number of middle turbinates removed by him. These were examined by Edgar Thurston, and a diagnosis of necrosed bone was made. The· opposition to the theories of Woakes was very general, Wilkins only supporting his views, while Spencer Watson, Creswell Baber, Moritz Schmidt, and others, were among his most vigorous antagonists. In 1887 Woakes again published twenty cases, with a pathological examination of each case, made by Sidney Martin. In two of these only was necrosis found; in eight the bone was normal; in ten there was partial absorption. The changes found by Sidney Martin are as follows: "The mucous membrane showed an increase of fibroid and myxomatous tissue with or without· small-celled infiltration. This myxomatous condition occurred either in the surface of the mucous membrane alone, or also in the trabeculæ of the bone, which had

expanded, causing absorption. The fibrosis of the mucous membrane caused atrophy of the glands by pressure, obliteration of the venous sinuses, thickening of the walls of the arteries, and cystic formation of the mucous membrane." In nine of the twenty specimens absorption of the bone was found. " This was shown in thinning of the bone and in the formation of Howship's lacunæ. These lacunæ are like little bays in the bony tissue; the edge of the bay next the bone is lined with loose fibrous tissue; sometimes there is an osteo-clast present. In some cases the absorption has progressed right across the lamella of bone, so that what was once bony tissue is now occupied by fibroid tissue. By this means progressive thinning and absorption of the bone is brought about. Necrosis in case number one was complete, in case number seven only partial, and the necrosed part in the latter case was adjoining the mucous membrane which embraced some of the trabeculæ of bone. In these cases diseased and partially occluded arteries were seen." Even after this second paper of Woakes no specialists were found who could confirm his views. Grunwald declared, however, that caries of the bone was common in cases of disease of the accessory sinuses and polypi. This statement, however, was denied by many authors at the time. Zuckerkandl combats the theory of Woakes, and states that in no autopsy on subjects afflicted with polypi has he ever found necrosis. Gordon showed in the London Laryngological Society a piece of polypoid turbinate macroscopically normal, in which, under the mi-croscope, appeared numerous osteoblasts, but no signs of necrosis. Of the later publications the best article I have been able to find on the subject is that of Hajek in the Archives für Laryngologie und Rhinologie for 1896. He reports five cases of catarrhal hypertrophy, seven of hyper-trophy connected with purulent discharge from the accessory sinuses, five cases of hypertrophy connected with polypoid growth, and twelve cases of polypi with bony attachments. Of the hypertrophic cases, he found in six evidence of hyperplasia, in three rarefying ostitis. Of the twelve cases of polypi with their bony attachments, five showed no patho-

logical lesion except cellular infiltration of the periosteum, three showed hyperplastic condition of the bone, and three showed rarefying ostitis. The material examined by me includes sections of thirty-two middle turbinated bones. Of these twenty-three were polypoid or attached to polypi; five were turbinates removed because they obstructed the flow of pus from the antrum, or because ethmoiditis was the lesion suspected; three were removed for neuralgia, the turbinate pressing upon the septum. These offer a good idea of a practically normal turbinate. One was removed post-mortem in a case of glanders, and one for cystic degeneration and obstruction. The examination was undertaken to ascertain, first, whether signs of necrosis of bone were present in any considerable number of turbinates undergoing polypoid degeneration; second, whether any constant condition of the mucous membrane, sub-mucosa, or bone was present in turbinate affected with polypoid growths. The conditions found may be divided into: First, the practically normal turbinate; second, the turbinate showing the superficial condition of inflammation; third, inflammation of the periosteum or of the marrow; fourth, new formation of bone with or without necrosis. The work was undertaken at the Pathological Laboratory of the Massachusetts General Hospital, with the kind permission of Dr. Wright, to whom I wish here to offer my thanks for much advice and assistance. The specimens were obtained at the Out-patient Nose and Throat Clinic at the same hospital, and for several of them I am indebted to the other members of the staff, Doctors Coolidge, Clark, and Goodale. The tissues were hardened in Zenker's solution, decalcified, embedded in paraffine, and stained with polychrome blue and eosin.

The normal middle turbinate (Fig. 1[1]) is covered with columnar ciliated epithelium, which occasionally dips inward, making distinct bays in the tissue, such bays being found even between the trabeculæ of bone (Fig. 2). In many places the epithelium was lacking over more or less considerable areas, owing to traumatism during removal.

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[1] The microphotographs were made for me by Mr. Brown, of Dr. Wright's laboratory.
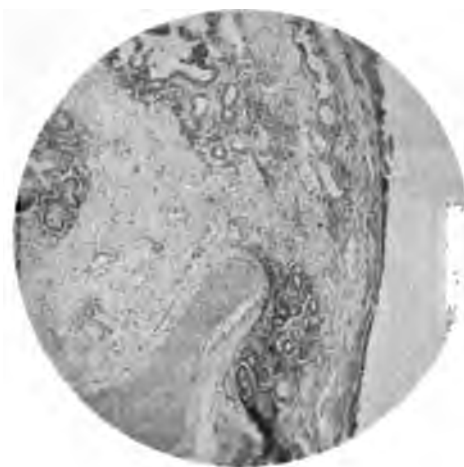
PLATE I.

FIG. I.
Objective, 16 mm. Zeiss apochromatic; ocular,
4 compensating; arc light.

FIG. 2.
Objective, Zeiss A₂; ocular, none; arc light.

Beneath the epithelium is a layer of loose connective tissue, more or less well supplied with mucous glands and blood vessels. Within this is the spongy bone lined with its thin periosteum and having large spaces in its interior filled (Fig. 3) with loose areolar tissue and blood-vessels, but not lined with epithelium. Superficial inflammation is indicated by the increase of small cells and the presence of fibrin in the connective tissue beneath the epithelium. The cells localize themselves especially, as pointed out by Hajek, about the glands, and are sometimes present in very large quantities. They are considered by some observers as the preliminary stage in the deeper inflammation of the bone. It is in the sub-mucosa that polypoid degeneration is most apparent. It usually occurs between the bone and epithelium of the surface, distending the loose areolar tissue and widely separating the epithelium from the bone and deep structures.

In this polypoid tissue small blood-vessels and glands sparsely scattered about and enclosed in a fine reticulum of connective tissue are to be found. Large cysts are not infrequently encountered here, probably owing to the stoppage of the ducts of the mucous glands, since the lining of such cysts corresponds to that of the ducts. These cysts in polypoid tissue may become so large as to occupy the whole interior of a polyp and cause it to collapse completely when punctured. The amount of sub-mucous infiltration does not furnish any indication as to the condition of the deeper changes in the bone and periosteum. Several specimens show a marked increase of leucocytes in the sub-mucosa without any change in the bone, while in others bone changes, even of quite an extensive character, appear without any large infiltration, and in still others both conditions are present. The most well-marked case of superficial cellular increase occurred where a turbinate had been bathed for a long time in pus from the antrum, but without becoming polypoid and with no changes in the bone. Plasma cells are scattered about normally in the sub-mucous layer, perhaps more frequently than in the deeper structures, although they are to be seen in both localities. Large cells in the bone

spaces and periosteum were seldom seen without extensive changes in the bone, although in one case osteoblasts were observed in large numbers in the periosteum lining these spaces, while careful examination failed to show any other pathological lesions either of the bone or sub-mucous layer. The involvement of the bone was shown by irregular thinning of its lamellæ, giving it an eroded appearance, or by the presence of islands of bone separated from each other by large numbers of osteoblasts (Fig. 4). This specimen was removed from a case of enormous polypoid hypertrophy of the middle turbinate, associated with a foul discharge from the nose, and complete darkness on translumination of the right antrum. Microscopical examination shows new bone formation without signs of absorption. The method of new formation in the bone is most interesting. The process is well described by Hajek and can be easily traced by referring to Fig. 5. The plasma of the osteoblasts furnishes the material for the new bone, which is formed around each, so that gradually every cell becomes embedded in newly formed bone. Fresh osteoblasts now form in layers on the new bone, and so the process of hypertrophy continues. Fig. 5 shows this process, in which normal, newly formed bone and bone in the process of formation are to be seen. This process cannot be found in all parts of the specimen, although osteoblasts are uniformly present. The conjunction of this process with that of absorption of bone or rarefying ostitis is more unusual, but has also been found. In this form giant cells are added to the picture and the trabeculæ present an irregular, worm-eaten appearance. This condition I have only found in one of the specimens examined. The destruction of the bone with no effort at regeneration is shown in the case of glanders examined, in which the worm-eaten appearance of the trabeculæ was very marked, and every portion of the tissue presented great cellular infiltration, but in which no sign of osteoblasts appeared. In order to obtain a histological examination of unquestioned necrosis two specimens of specific sequestra were taken, one from the upper jaw and one from the septum. Both speci-

PLATE 2.

FIG. 3.
Objective, 24 mm. Leitz; ocular, 2 compensating; arc light.

FIG. 4.
Objective, 8 mm. Zeiss apochromatic; ocular,
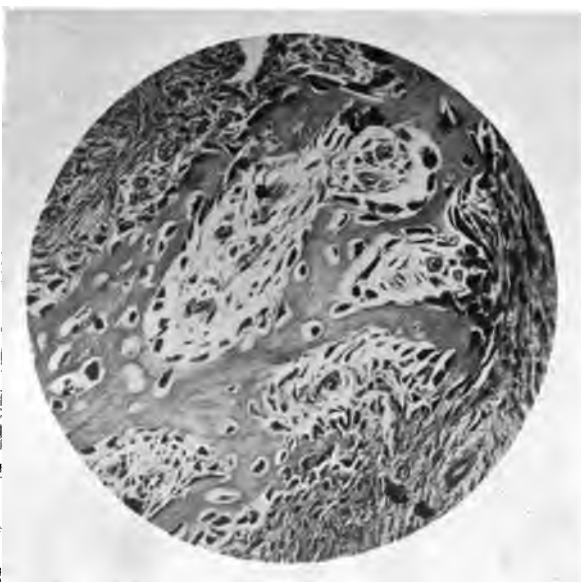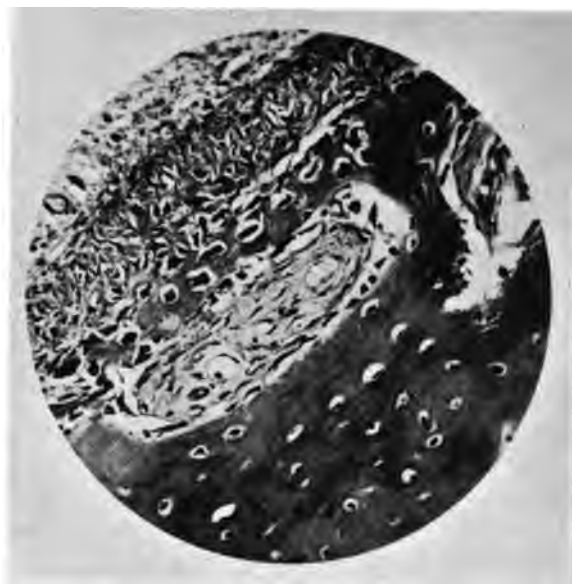4 compensating; arc light.

PLATE 3.

FIG. 5.
Objective, 8 mm. Zeiss apochromatic; ocular,
4 compensating; arc light.

FIG. 6.
Objective, 8 mm. Zeiss apochromatic; ocular,
4 compensating; arc light.

mens were subjected to the same treatment as the turbinates, being preserved in Zenker's fluid and decalcified and embedded in paraffine. In both the nuclei failed to stain with polychrome blue, while the bone took the eosin stain well. In the sequestrum from the jaw (Fig. 6) giant cells were seen in considerable numbers, while in the second only small cells and bacteria were present. In no case of the turbinates examined was there any failure of the nuclei to stain, although in two specimens occasional giant cells were to be seen.

In Fig. 6 we have a photograph of the necrosed sequestrum from the upper jaw, showing the failure of the bone nuclei to take the stain and the presence of giant cells in Howship's lacunæ.

Of the twenty-three cases of polypi examined in which portions of the middle turbinate were removed with the growth, six showed changes in the bone, all but one being confined to the formation of new bone, and one containing a considerable number of osteoblasts with signs of bone absorption, and therefore coming under the head of rarefying ostitis. In no other case could signs of change in the bone be discovered. Of the three cases of removal of the turbinate on account of neuralgia caused by its pressure on the septum, one showed a considerable infiltration in the sub-mucosa, although in all the bone was normal. Of the five cases removed because of the obstruction to the flow of pus from the antrum, three showed a considerable infiltration in the sub-mucosa, but no affection of the bone, while one which showed no infiltration had large numbers of osteoblasts lining the periosteum. Clinically the turbinate showed no abnormality in size or appearance. The results obtained harmonize with those of Hajek in the absence of necrosis and the presence of hyperplasia rarely associated with rarefying ostitis.

Fig. I. (Plate 1.) — Normal turbinate, showing bone, glands, etc.
Fig. II. (Plate 1.) — Shows involution of mucous membrane into a cavity formed by bony trabeculæ.
Fig. III. (Plate 2.) — Shows spaces in spongy bone containing blood vessels and loose areolar tissue.

Fig. IV. (Plate 2.) — Shows newly formed bone, surrounded by osteo-blasts.

Fig. V. (Plate 3.) — In lower portion of figure is shown normal bone; partially separated from this by connective tissue and blood vessels is a layer of recently formed bone. External to the latter again is a layer of dense connective tissue in process of being transformed into osseous tissue by calcification of the inter-cellular substance.

Fig. VI. (Plate 3.) — Necrosed bone, showing the failure of the nuclei to take the stain and the presence of osteoclasts in Howship's lacunæ.

SOME OF THE MORE RECENT METHODS DEVISED FOR THE DIFFERENTIATION OF THE TYPHOID FROM THE COLON BACILLUS.

MARK W. RICHARDSON, M.D.

(From the Pathological Laboratory of the Massachusetts General Hospital.)

The reader demonstrated:

I. Two solutions devised by Proskauer and Capaldi. (Zeit. für Hygiene, Vol. XXXIII., Part III.)

The solutions are neutral in reaction and colored with litmus. In solution No. 1 the typhoid bacillus does not grow at all. The colon bacillus not only grows rapidly, but also produces a marked acid reaction, and the blue color gives way to a red. In solution No. 2 both typhoid and colon bacilli grow, but in this case the typhoid bacillus should be the only one to produce an acid reaction. In the reader's experience, however, the differentiation given by this solution has not been very sharp, and its value is not great unless combined with other tests.

II. Solution of Thoinot. (Semaine Medicale, 1898, p. 126.) This medium consists of ordinary bouillon to which one one-hundredth per cent. arsenious acid has been added. In this solution the typhoid bacillus does not grow at all. The colon bacillus grows rapidly.

III. Two test media of Hiss. (Jour. of Exper. Med., 1897, No. 6.) These two media are made up of gelatin, agar, beef extract, salt, and glucose in such combination that at 37 degrees C. they become semi-solid. The typhoid

bacillus then, by reason of its motility, produces in them appearances which are characteristic.   Both media are acid in reaction, and the growth of bacteria requiring an alkaline reaction is thus inhibited.

The first or " tube medium " is used for the differentiation of the typhoid bacillus when already obtained in pure culture.   In this instance the bacillus is able to wander through the semi-solid nutrient material, and thus to cause a general clouding of the medium.   Gas is not produced.

The colon bacillus, on the other hand, having ordinarily but slight motility, grows only along the line of inoculation. There is, furthermore, a considerable production of gas. The motile varieties of the colon bacillus give a combination of the two appearances — general clouding and gas production.

The second or " plate medium " of Hiss is used for the isolation of the typhoid bacillus from mixtures of bacteria such as are seen in typhoid stools.   In this instance also the motility of the bacillus, combined with a semi-solid medium, gives to the typhoid colonies an appearance so characteristic that they can be differentiated easily from those of the omnipresent colon bacillus.   The differences are as follows: The colon colonies are larger, darker, sharply defined, and more coarsely granular.   The typhoid colonies are smaller, paler, and, instead of being sharply defined, have a fringe of filaments projecting from the periphery.   This medium is certainly the best which has been devised up to the present time for the isolation of the typhoid bacillus from the stools.

· Finally the reader referred to a procedure, original, as far as he knows, with himself, for the recognition of typhoid colonies upon ordinary agar plates.

If one examines carefully the rent in a typhoid colony made in the process of inoculation, one can see, oftentimes, even with a low power of the microscope, a seething motion resembling much the appearance of a swarm of bees   This motion becomes much more apparent when a higher objective, such as a Zeiss DD or a Leitz No. 7, is used.   This

phenomenon is due, of course, to the fact that the motile bacilli have been freed from restraint and are simply exercising their powers of locomotion.

Having demonstrated that the colony is made up of motile bacilli, we next touch the colony with a very small amount of typhoid serum, and we find that the motion ceases instantly and almost absolutely. The procedure is, thus, simply another application of the Widal serum test. In this case, however, we cannot make out a distinct clumping of the bacilli, though a suggestion of this is present. Colonies of other motile bacilli, such as the bacillus pyocyaneus and motile varieties of the colon bacillus, show, when touched with typhoid serum, a considerable diminution, oftentimes of motility, but the loss of motion is never absolute, and individual organisms retain their motility unimpaired.

By the use of this procedure the reader has been able to isolate the typhoid bacillus from the single typhoid stool which he has examined.

THE ACTION OF TYPHOID BACILLI ON MILK AND ITS PROB-ABLE RELATION TO A SECOND CARBOHYDRATE IN THAT FLUID.

THEOBALD SMITH, M.D.

It seems to be generally accepted, and stated in the most recent text-books, that the typhoid bacillus is peculiar as a producer of acid, more especially in milk and in the litmus whey of Petruschky,[1] made from it by removing casein and fat. Apparently in conflict with this view is the statement I have repeatedly made that lactose is not acted upon by typhoid bacilli when dissolved in dextrose-free bouillon. Drawn into some experiments touching this subject recently for another purpose, I studied series of cultures in fermentation tubes to explain, if possible, this discrepancy. The figures I shall give show that while typhoid bacilli produce acid in milk, they produce neither more nor less than other related bacilli which do not attack lactose. They do, how-

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[1] Bakterio-chemische Untersuchungen. Centralbl. f. Bakteriologie, VII. (1890), pp. 1 and 49.

ever, differ from them in one important particular, — that of alkali-production, — which is responsible for these seemingly conflicting views.   There is also another interesting question involved which concerns the nature of the substance in milk yielding the acid.   This I take to be dextrose (glucose) or some carbohydrate closely resembling it.   In order that the method of proof used may clearly be understood, I will briefly quote the principles upon which it is based.

1. Many bacteria, while acting on any carbohydrates present in culture fluids to form acids, at the same time produce in the presence of air an alkali.   The alkali production is linked to the multiplication of bacteria, and seems to vary directly with the vigor of growth.

2. This double process, which, in the presence of air, may be masked by mutual neutralization of the acid and alkaline bodies formed, is best studied in the fermentation tube, because in the closed branch alkali production is inhibited and acid production unchecked.

3. Fluids free from carbohydrates do not support life in the closed branch, i.e., under anaërobic conditions.

4. Peptones do not yield acids.   This seems restricted to those sugars which the bacteria under observation are able to decompose.

5. When a fermentescible sugar is present, the production of acid goes on until the sugar is used up, or, if the latter is present in excess, until growth is inhibited by the acid formed.

6. The amount of sugar which can be decomposed by bacteria before inhibition begins varies somewhat with the species, but probably does not exceed 0.5 per cent. unless neutralizing substances like $CaCO_3$ be added.   These propositions I have repeatedly demonstrated by series of experiments which have been published in detail.[1]

At the outset it is of importance to examine briefly what action typhoid bacilli have upon sugars.   That they act vigorously upon dextrose is known, but because gases are not set free the acid production is frequently overlooked.

[1] See Centralblatt f. Bakteriologie, VIII., p. 389; XI., p. 367; XIV., p. 864; XVIII., p. 1; XXII., p. 45.

March 7, 1898. In the closed branch of two fermentation tubes containing a one-per-cent. dextrose bouillon, and inoculated eight days ago with typhoid II. and III., the acid reaction of the bouillon had risen from 1.5 to 5.38 and 5.43 respectively.[1]

March 30. A five-day culture of typhoid bacilli in fluid of the same composition gave the following figures: Open bulb, — 4.86; branch, — 4.43.[2]

A simple demonstration of the selective action of typhoid bacilli on dextrose may be made by adding 0.5 to 1 per cent. of dextrose in sterile solution to milk in ordinary test tubes. After 3 to 5 days the casein, if not already precipitated through acid production, may be precipitated by immersing the tubes in hot water. The typhoid bacillus also acts upon the muscle sugar contained in beef which finds its way into bouillon.

May 30. A nine-day culture of typhoid III. in ordinary peptone bouillon with an initial acidity of 1.5 has a reaction for the open bulb of + 0.35; for the branch, — 2.64. Here we note the alkali production, which amounts to 2.64 + .35 or 2.99 per cent. The acid production is equal to 2.64 — 1.5 or 1.14 per cent.

The absence of acid production in the presence of saccharose and lactose in dextrose-free bouillon is shown by the following figures:

Saccharose bouillon, — 1.3[3] $\begin{cases} \text{bulb, } - 0.28. \\ \text{branch, } - 1.30. \end{cases}$

Lactose bouillon, — 1.3 $\begin{cases} \text{bulb, } -0.15. \\ \text{branch, } - 1.36. \end{cases}$

Here the reaction of the branch fluid remains nearly unchanged, because the absence of an available sugar prevents growth without oxygen. In the bulb, however, there is active growth with alkali production.

We are now prepared to return to milk cultures. In order to bring out certain features of these more distinctly

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[1] These figures signify that so much of a normal solution of acid or alkali percentum is required to bring the culture fluid to the phenolphthallein neutral point. For the method of titration employed, see " Procedures Recommended for the Study of Bacteria," Concord, N.H., 1898, p. 18.

[2] — signifies here acidity; + alkalinity.

[3] Initial reaction of bouillon.

I have drawn into the study several varieties of hog-cholera (swine pest) bacilli, a bacillus of pseudo-tuberculosis described in this journal (vol. I., no. 16, p. 12) and closely related to the preceding, and a fowl disease bacillus[1] which resembles the typhoid bacillus closely, but which is non-motile. These were the only bacteria at my disposal which act on dextrose, but do not act on lactose. Those which do, like the large colon group, cannot be utilized. Nor can bacteria be used which do not act on dextrose, like many strictly aërobic forms. A few illustrations of milk cultures of these bacilli in fermentation tubes will make their action clear.

4-day culture of typhoid I., — 1.74 $\begin{cases} \text{bulb, — 3.18.} \\ \text{branch, — 3.06.} \end{cases}$

4-day culture of hog-cholera I., — 1.74 $\begin{cases} \text{bulb, — 0.64.} \\ \text{branch, — 3.19.} \end{cases}$

5-day culture of typhoid II., — 2.04 $\begin{cases} \text{bulb, — 3.07.} \\ \text{branch, — 3.04.} \end{cases}$

5-day culture of typhoid III., — 2.04 $\begin{cases} \text{bulb, — 2.95.} \\ \text{branch, — 2.92.} \end{cases}$

9-day culture of pseudotuberculosis, — 2.04 $\begin{cases} \text{bulb, — 0.3.} \\ \text{branch, — 3.08.} \end{cases}$

9-day culture of fowl disease, — 2.04 $\begin{cases} \text{bulb, — 0.43.} \\ \text{branch, — 3.12.} \end{cases}$

9-day culture of typhoid I., — 1.66 $\begin{cases} \text{bulb, — 3.07.} \\ \text{branch, — 2.91.} \end{cases}$

9-day culture of typhoid III., — 1.66 $\begin{cases} \text{bulb, — 2.81.} \\ \text{branch, — 3.03.} \end{cases}$

9-day culture of hog-cholera II., — 1.66 $\begin{cases} \text{bulb, — 0.} \\ \text{branch, — 2.68.} \end{cases}$

An examination of these figures will show that the amount of acid produced in the closed branch is nearly the same for all the bacteria under observation. In the bulb, however, the conditions are different. While the related bacilli produce considerable alkali, as shown by the fall in the acidity, the typhoid cultures produce no alkali. The reaction remains

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[1] V. A. Moore. Rep. Bur. Animal Industry for 1895-6, p. 188.

stationary after the acidity has reached its maximum.[1] If
the acidity of these cultures were due to lactose, it is quite
difficult to understand· why so little acid is formed in the
presence of so much sugar, and also why the same amount is
formed by all cultures alike. I have already pointed out
that if dextrose be added to milk, acid production goes on
to the precipitation of casein. The simplest explanation is
the presence of very small amounts of dextrose. The uni-
form results quoted above apply to four different lots of
milk from two dairies, and cannot therefore be looked upon
as accidental. The fact that typhoid cultures remain acid is
probably due to the unfavorable character of milk as a cult-
ure fluid, since alkali is produced abundantly in bouillon.

If a fermentescible carbohydrate, such as dextrose, is
present in milk, it would be likely to appear in milk-sugar in
traces. More than this is not to be anticipated, since the
greater solubility of dextrose would lead to its elimination
during the crystallization of the lactose. The following
7-day cultures of typhoid bacilli show that with an increase
in the quantity of lactose there is a corresponding increase
of acid:

Dextrose-free bouillon (control-tube), — 1.5 $\begin{cases} \text{bulb, — 0.86.} \\ \text{branch,—1.59.} \end{cases}$

1.8 per cent. lactose bouillon, — 1.5 $\begin{cases} \text{bulb, + 0.05.} \\ \text{branch, — 1.63.} \end{cases}$

4.1 per cent. lactose bouillon, — 1.5 $\begin{cases} \text{bulb, + 0.05.} \\ \text{branch, — 1.94.} \end{cases}$

6.66 per cent. lactose bouillon, — 1.5 $\begin{cases} \text{bulb, + 0.0.} \\ \text{branch, — 2.1.} \end{cases}$

The following 5-day hog-cholera cultures furnish the same
evidence. In the second and the third tube a gas bubble
appeared, as a further indication of the presence of dextrose:

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[1] The slight decrease in the acidity of the last culture is probably due to slight inter-
changes of fluid between bulb and branch. The greater the difference of reaction be-
tween the two branches of the tube, the more conspicuous this defect becomes. When
gases are formed the fluctuations of volume due to opening and closing of the incu-
bator and to removal of the tube to a lower temperature for examination will reduce
the acidity of the branch quite appreciably by drawing fluid from the open into the
closed arm and forcing it out again.

1.8 per cent. lactose bouillon, — 1.5 $\begin{cases} \text{bulb, } + \text{o.15.} \\ \text{branch, } — \text{1.67.} \end{cases}$

4.1 per cent. lactose bouillon, — 1.5 $\begin{cases} \text{bulb, } — \text{o.10.} \\ \text{branch, } — \text{1.94.} \end{cases}$

6.66 per cent. lactose bouillon, — 1.5 $\begin{cases} \text{bulb, } — \text{o.38.} \\ \text{branch, } — \text{2.06.} \end{cases}$

The presence of another carbohydrate in milk is merely hinted at in works I have been able to consult. Nothing definite seems to be known about it, and it is usually ignored.[1] That dextrose should be present is not strange, but rather to be anticipated, as it is an acknowledged constituent of tissues and organs. In normal urine Baumann and Wedenski found about 0.09 per cent.[2] An acid-producing substance is readily demonstrated with the fermentation tube in animal tissues. By forcing bits of sterile tissue, as large as peas, from animals just chloroformed, into the closed branch of tubes containing dextrose-free bouillon, and inoculating with B. coli, or related forms, I obtained the following figures after 6 days:

Spleen of guinea-pig (B. coli), — 1.55 $\begin{cases} \text{bulb, } + \text{o.3.} \\ \text{branch, } — \text{2.27.} \end{cases}$

Spleen of guinea-pig (hog-cholera ba- $\begin{cases} \text{bulb, } + \text{o.1.} \\ \text{branch, } — \text{2.04.} \end{cases}$
  cilli),   — 1.55

In order to determine approximately the amount of the dextrose-like body present in milk, different quantities of dextrose[3] in sterile solution were added to dextrose-free bouillon in fermentation tubes and the series inoculated with typhoid III.   After 3 days the following condition was observed:

Control tube, — 1.32 $\begin{cases} \text{bulb, } — \text{o.44.} \\ \text{branch, } — \text{1.11.} \end{cases}$

Bouillon plus o.05 per cent. dextrose, — 1.32 $\begin{cases} — \text{o.3.} \\ — \text{1.89.} \end{cases}$

Bouillon plus 0.075 per cent. dextrose, $\begin{cases} \text{bulb, } — \\ \text{branch, } — \text{2.15.} \end{cases}$
  — 1.32

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[1] See Hammarsten Physiol. Chemie. (1895), p. 386.

[2] Hoppe Seyler's Handbuch (1893), p. 60.

[3] The dextrose used in these experiments is the anhydrous powder.

Bouillon plus 0.1 per cent. dextrose, — 1.32 $\begin{cases} \text{bulb,} — \\ \text{branch,} — 2.47. \end{cases}$

Bouillon plus 0.15 per cent. dextrose, — 1.32 $\begin{cases} \text{bulb,} — 0.55. \\ \text{branch,} — 3.03. \end{cases}$

By comparing the increase in the acidity of the branch fluid in these tubes with that of the milk tubes tabulated above, we note that the amount of dextrose or related body in milk is about 0.1 per cent., or nearly the amount found in normal urine.

Petruschky found the amount of acid produced in litmus whey by typhoid bacilli 0.2 to 0.3 per cent. of a normal solution. The amount produced in fermentation tubes is fully one per cent. The difference is probably due to the methods employed. Petruschky classed the hog-cholera bacillus as an alkali producer, the typhoid bacillus as an acid producer. The figures I have given both explain and destroy his classification. It would now be nearer the truth to state that both are acid producers, but that only one is an alkali producer in milk.

Another method, introduced by Prof. W. H. Welch, consists in the use of milk to which litmus has been added. With this modified milk, acid production by typhoid bacilli is evidenced by a change in color within 48 hours. The hog-cholera group of bacteria also shows this change, but it soon becomes confused with a reducing process which after 5 or 6 days leads to a complete but temporary decolorization of the litmus excepting at the surface. This reducing action is not noticed in milk cultures of typhoid or the fowl disease bacilli. In about 10 days the color returns to the hog-cholera tubes which have in the meantime become alkaline, while the typhoid cultures still show a reddish tint of the litmus. The reducing action seems to be due simply to a greater vigor of growth. The returning color (oxidation) indicates a slackening of the growth of the bacilli which enables the oxidizing action of the air to overshadow the enfeebled reducing action of the bacteria.[1]

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[1] Theobald Smith. Reduktionserscheinungen bei Bakterien. Centralblatt f. Bakt., XIX. (1896), p. 181.

There can be no question that the absence of alkali-pro-
duction in milk is an important character of typhoid bacilli,
and should not be neglected when questions of identity arise.
Petruschky has emphasized this point in the description of a
bacillus from feces which resembles the true typhoid bacillus
very closely, but produces alkali.[1] Though the serum test
has now entered as the most weighty evidence in deciding
whether suspected bacilli are typhoid or not, it would be
highly unwise and misleading to rely upon this alone and
neglect to study the important characters of the species. All
avenues for the detection of variations would thereby be
blocked, while, at the same time, the significance of the agglu-
tinative action of the blood as manifested towards different
species of bacteria would continue to remain a matter for
speculation.

For acid and alkali production I would recommend the
use of milk in fermentation tubes and the titration of the fluid
in open and closed arms. This process is superior to the
use of litmus whey and litmus milk, since it gives quantitative
results and employs a more reliable indicator. Litmus milk is
serviceable in supplementing this method, as it shows to the
eye changes of reaction and indicates by the phenomena of
reduction the relative vigor of multiplication and the time
when this begins to languish and cease. Uniform narrow
tubes should be used, and the column of liquid should be
of the same height if the phenomena of reduction are to have
any comparative value. The main points of this article may
be epitomized as follows:

1. Typhoid bacilli produce alkali in bouillon, but not in
milk.

2. Typhoid and closely related bacilli which do not
coagulate milk (do not act on lactose) produce an equal
amount of acid in this fluid.

3. In milk there is a substance, present to about 0.1 per

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[1] *Bacillus fæcalis alcaligenes.* Centralblatt f. Bakt., XIX., p. 187. See also Capaldi
and Proskauer. Beiträge z. Kenntniss d. Säurebildung bei Typhusbacillen u. Bact.
Coli. Ztschr. f. Hygiene, XXIII. (1896), p. 452.

cent., which resembles dextrose in its behavior towards bacteria.

4. The comparative slowness with which changes of reaction take place in milk cultures indicates that it is a less favorable medium for certain bacteria than peptone bouillon.

A WATER MOTOR FOR ACTUATING A KYMOGRAPH DRUM.

G. W. Fitz.

The motor consists of a bicycle pump with an outlet tube carrying an orifice so that the outflow may be graduated either by raising and lowering the orifice or by using larger and smaller openings.

A cord attached to the piston of the bicycle pump is carried around a pulley on the kymograph drum and thence over an idler pulley to a small counterpoise weight. It is arranged so that one movement of the piston actuates the drum for one complete rotation. The piston is raised by pulling on a cord which automatically closes the outflow tube and opens the supply tube. When the piston is raised to the top the supply tube is automatically closed and the outlet tube may be opened whenever records are desired. The changes in speed are sufficient to give variations from one rotation in an hour to one in one-half minute.

The apparatus cannot be used for myographic tracings, where a rapid succession of records is required on one portion of the drum, or for records in which (*e.g.*, the chronoscope) absolute uniformity of motion is required, and dependence is made on the rotation of the drum itself for time intervals. In other work it gives a regular and easily controllable motion.

SPECIAL NOTICE.

The Journal will be published *immediately* after the meetings of the Society, and will contain authors' abstracts of the papers presented, when these papers are not given in full.

By general consent of the Heads of Departments it will contain full abstracts of experimental work carried on in the following institutions: the Medical School of Harvard University, the Experiment Laboratories of the Massachusetts General and the Boston City Hospitals, the Physiological and Biological Departments of the Massachusetts Institute of Technology, Clark University, and the Anatomical Laboratory of Brown University.

Papers and abstracts of papers upon subjects connected with the Medical Sciences will be welcomed from persons not members of the Society, and if approved by the Council will be presented at the meetings, and will be given a place in the Journal.

When desired, the insertion of papers, if in abstract, will be accompanied by a note indicating the place where they may be found in full. Fifty reprints will be furnished free to authors if the desire for them be expressed on the manuscript.

Subscribers to the Journal are invited to attend the meetings of the Society; the next will be held on October 18, at the Harvard Medical School, at 8 P.M.

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